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Photo Elicitation Methods in Engineering Research

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PHOTO ELICITATION METHODS IN ENGINEERING RESEARCH

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ABSTRACT

Construction research often uses case study methods to investigate the large and singular projects that are a hallmark of the profession. These studies increasingly use informant interviews as a strategy to develop detailed case based knowledge. In contrast, photo elicitation uses photographs or other images in interviews to elicit informant knowledge, and is particularly well suited for understanding knowledge and perspectives other than the researchers'. As such photo elicitation has particular potential for researchers interested in sustainability, human factors in design, and other transdisciplinary topics. This method has a rich history in many academic disciplines; however, to date it has not been applied in construction research. This paper presents the method and suggestions for its application in construction research, drawing from insights gained in other disciplines to develop recommendations that can be used to achieve high quality research results. It also presents important limitations, benefits, and ethical considerations of the method important for a researcher to consider when applying it to construction and engineering research.

KEYWORDS: Visual Research Methods, Qualitative Methods, Photo Elicitation, Research Ethics

INTRODUCTION

Photo elicitation is the use of photographs as prompts in a research interview. The subsequent data analysis may consider just the resulting interview text or may also include analysis of the images themselves. This latter is particularly appropriate when the research asks research participants themselves to take the photographs that are later used as interview prompts. While this method has been in use in other disciplines since at least the 1960s (Collier 1967) it has yet to be applied to construction research. For example, a search of the ASCE Library for “photo* elicitation” identified zero published items in the online library. Similarly, a Web of Science search for the same topic keywords returned zero articles in the civil engineering category. A search of the Engineering Project Organization Journal also returned zero articles, with just a single article in that journal (Gottlieb and Jensen 2012) mentioning photo documentation as a research tool.

In contrast, as of April 2014 there are 177 peer-reviewed article results across all disciplines, with the method appearing most frequently in the Web of Science Topics of public environmental occupational health (27), social sciences interdisciplinary (26), sociology (22),

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hospitality leisure sport tourism (16), education educational research (13), and environmental studies (12). Within these interdisciplinary studies, a few have relevance for engineering research, as will be discussed in the literature review below. Because of this method's novelty to the infrastructure research community, we provide a description of photo elicitation, a general procedure for employing it, a discussion of its strengths and limitations, ethical issues particular to visual research, and considerations for its use in construction research. The intent of this article is provide information specific to construction research that can help researchers determine if this method will aid them in answering their research questions.

WHY VISUAL RESEARCH?

Qualitative methods are becoming more common in engineering and construction research. They provide a valuable service to engineering research, both by investigating different questions that cannot be accurately analyzed through quantitative methods and also by validating or problematizing quantitative findings using a different approach. Much as the analyses of nominal and ordinal data require different statistical methods, different research questions may suggest qualitative, quantitative, or mixed methods. For exactly this reason, qualitative methods have begun making excellent contributions to the body of knowledge regarding our built environment and the designs we create for them. To date, however, most of the qualitative research in engineering and construction has focused on text resulting from informant interviews or surveys (for example, see Kaminsky and Javernick-Will 2013). The lack of visual analysis to match or improve textual analysis should be surprising in engineering and construction, as these fields have long depended on the creation and interpretation of visual images such as design drawings. However, with a few key exceptions, our academic community has neglected extending this acknowledgement of importance into research practices.

We should pause here to differentiate between photo documentation and photo elicitation. The former has been used extensively in infrastructure engineering practice and research. For these studies, photographs are taken in order to document some part of a project or piece of infrastructure. While both of these methods involve taking photographs, the theoretical difference is important. Photo documentation deals with the visible, or those material things that can be seen and, arguably, have a singular and observable reality. For example, photographs may be taken to provide evidence that a particular size pipe was placed in a trench before it was backfilled. Photo elicitation, alternatively, deals with the visual. (Pink 2006 p. 23) The visual is different than the visible because it is mediated through human interpretation. In other words, the visual signifies something other than, and only potentially connected to, what is actually shown in the image. For example, a single image of a delicate seahorse swimming near the outlet pipe of a plant cannot tell us much about the actual environmental impact of the pipe discharge, but it may still be shown in order to make a point. The visual deals with representations, or with culturally mediated communication through images. The immediately apparent limitation of the multiplicity of meanings that can be read into an image are also the strength of this method. By asking our respondents to respond to an image, we are asking them

to carefully consider (and potentially create) that image and then explain that creative, cognitive process. This allows us to move from the merely visible to the visual. The thoughtfulness and freedom of creativity involved in this process result in detailed data created outside of the researcher's own framework, and gives us new access to the knowledge of other people.

This strength suggests that these methods are particularly appropriate for questions dealing with transdisciplinary topics such as sustainability, climate change, or human factors in design. These research interests often deal with perceptions, human behavior, and the technology-society nexus where engineers must deal with far more than designing steel or concrete. Visual methods are also particularly appropriate for research questions dealing with the physical, built environment (which is visible and can be reliably reproduced in a photograph) and people's experience of it (the visual, interpretive side that depends on informant experience.) For example, Banks (2001 p. 92; van der Does et al. 1992) describes a project in which a photo-elicitation project had great difficulty in visualizing the concept of ethnic integration, but no trouble at all producing images of places such as streets, squares, and playgrounds relevant to the meaning of the built environment. This suggests that visual methods are particularly relevant to infrastructure research.

As with any tool, in order to be used a research method must be clearly defined in relation to the issues at hand. As such, this article sets out key concepts in photo elicitation and visual methods in specific relation to engineering and construction research. We also discuss key benefits and limitations of visual methods, and identify several key ethical issues particularly relevant to visual research.

VISUAL METHODS THEORY

A key theoretical underpinning of visual research is that images do not have a singular objective meaning. Rather, the meaning of the image is culturally created and may change based on, for example, the exact historical moment at which it is looked at. Images are representations of something as well as images of physical or digital objects; these representations are why they are of interest to engineers, as these representations of the physical can give insight into how and why we design technology.

The analysis of visual images may be concerned with the image itself, with the producer of the image, or with the viewer of the image. Alternatively, we may be concerned with just the text, with contextual information, or even with the enacted social practices that use the image (Jewitt and Leeuwen 2001). We may also be concerned with the site of the image, such as are the site of production, the site of the image itself, and the site of audiencing (Rose 2006). In other words, there are many potential units of analysis for any given image. The unit of interest appropriate for the researcher is, of course, dependent on the research question.

The richest results from photo elicitation methods may seem almost unrelated to the specific images used during interviews. Instead, the value may instead be the release of memories, thoughts, and insights triggered by the image (Jewitt and Leeuwen 2001). In other words, we may gain information and knowledge that the informant connects to the image due to

personal or project history rather than specific image content. This suggests certain types of questions that are appropriate for photo elicitation research. For example, it would be absurd to select photo elicitation to investigate the tensile strength of beams. Photo elicitation privileges the voice of research participants; in other words, its strength is understanding the perspectives of people.

In construction research, any topic dealing with constituent experience should consider the use of this method. For example, job site communication, safety, intra-firm organization, diffusion of a new technology, productivity, and user experiences of the built environment are all topics where photo elicitation methods could provide valuable new insights. As construction research often and necessarily considers both people and technology, visual research is an important tool to our research method repertoire.

LITERATURE REVIEW

Visualization in Construction Research

While photo elicitation is not currently used in construction research, there is a large community interested in the benefits and impacts of visualization tools, including virtual reality (VR), geographical information systems (GIS), four dimensional computer aided design (4D CAD), and building information modeling (BIM). For example, researchers are interested in the impacts of visualization on building awareness of construction safety among workers (Hadikusumo and Rowlinson 2004; Rozenfeld et al. 2009; Zhou et al. 2012). Others are interested in using virtual reality to aid construction planning (Kamat et al. 2011; Li et al. 2003) or architectural site design (Bouchlaghem et al. 2005). Observational productivity (Leicht et al. 2010; Yi and Chan 2014) is another important research area where construction researchers collect visual data in an attempt to improve projects. Beyond the job site, research focuses on the performance of global teams (Di Marco et al. 2010) or how visualization tools diffuse across industry (Taylor 2007).

These and other publications recognize the importance of visualization in construction. They variously evaluate ways that visualization tools can improve both the processes and outcomes of projects. However, we have not yet extended this recognition of advantages to research processes and outcomes. In doing so, we are neglecting an important source of data. Indeed, in many instances visual data is already being created and collected. If a practitioner works to build a virtual reality model intended to improve safety outcomes, the places and things chosen for inclusion in the model also tell us something important about risk perception and safety culture. While these respondents are not using cameras to create images, the resulting images are still visual representations of the (sometimes designed but not yet extant) visible world, and thus provide rich data for visual analysis. Generally, my claim is that by analyzing images directly, and also by using these images as interview prompts, we can gain additional insights to construction research questions. However, as in this paper I am most concerned with photo elicitation, I next turn to the literature dealing directly with this variant.

Photo Elicitation

There is a reasonable amount of literature produced outside of construction and engineering journals that uses photo elicitation methods. A limited amount of this work has topical relevance to construction research; representative papers are discussed below.

This literature presents some consistency. There is a focus on what we may call non-traditional knowledge, for example from children or disadvantaged respondents. In addition, non-traditional knowledge is seen as important for the research questions being asked, which often deal with change (either what needs to change or what a proposed change might look like). Along these same lines, questions of sustainability are specifically investigated in many of these papers, especially those coming out of Australia. Sustainability and change, both dependent on the passage of time, are interrelated. Social sustainability in particular is dependent on local sociocultural systems and belief frameworks; local knowledge is particularly important to this research topic. Another reason the literature gives for the use of visual methods is that other methods have sometimes failed to produce satisfactory answers to research questions; indeed, it was a situation like this that first led the author to investigate visual methods. From this general analysis, we move to a presentation of specific papers.

Toetzer et al. (2011) uses photo elicitation methods to explore transdisciplinary work for sustainable design. They note that transdisciplinary work and methods seem particularly relevant for issues such as sustainability. They used photo elicitation to “gain insights into...children’s thinking in a very intuitive and spontaneous way (Toetzer et al. 2011 p. 848)”. In this project, children were a stakeholder in a project intended to address city planning in the context of urgent urban issues such as climate change. Children were invited to take photographs of urban sites, and researchers provided historical photos of the same sites. Children were then invited to develop paintings and write essays about those sites using the photos as a prompt.

Similarly, Dzidic and Green (2012) use photo elicitation in the context of sustainable urban design. In this case the project sought to understand urban water use patterns and barriers to the adoption of sustainable design options. Researchers provided images of aesthetically degraded water and through a questionnaire asked respondents about their willingness to use it for non-potable use in the home. While respondents were later interviewed, photographs were not used as prompts except through a general invitation to reflect on the previous ranking process.

Ray and Smith (2011) use photo elicitation to study organizational change while noting the lack of visual methods in organizational research. Researchers took photographs that were subsequently discussed in interviews with organizational constituents. They note that the photographs the researchers took did not resonate with respondents and that they abandoned the photos for traditional interview methods until the respondents themselves suggested how relevant photographs should be composed. Ultimately, they conclude that photographic methods are useful—though challenging—for investigating organizational phenomena such as internal processes and change.

Van Auken and Rye (2011) discuss land use planning in rural community development. In this review, this paper represents a variety of landscape change research that is relevant to anyone involved in building infrastructure in rural communities. In this study, participant photographs were used as focal points for individual interviews focused on perceptions of social and environmental change. This project ultimately analyzed transcribed interview text rather than the images themselves.

Purcell (2009) discusses photo elicitation as one of several photographic methods intended as a tool of community development and change. This genesis includes action research techniques such as PhotoVoice (Wang and Burris 1997). While the general research process includes using photos as prompts in interviews, the ultimate goal of the method is to empower individuals for positive change. The mechanism for this empowerment is the participant's self-recognition of negative aspects of the research topic. This is an important theoretical difference.

Badowski et al. (2011) used a photographic method to explore water and sanitation practices in homes in Tanzania. Households were loaned cameras and then mothers were interviewed about the photographs. They chose this method because they note that previous studies using oral or survey methods had been unable to link behaviors to poor hygiene practices, perhaps because of issues of people reporting socially desirable answers rather than actual practices.

Fusco et al. (2012) uses photo elicitation methods to investigate children's experience with the transport-built environment. They use the technique in order to account for individual interpretation of the built environment.

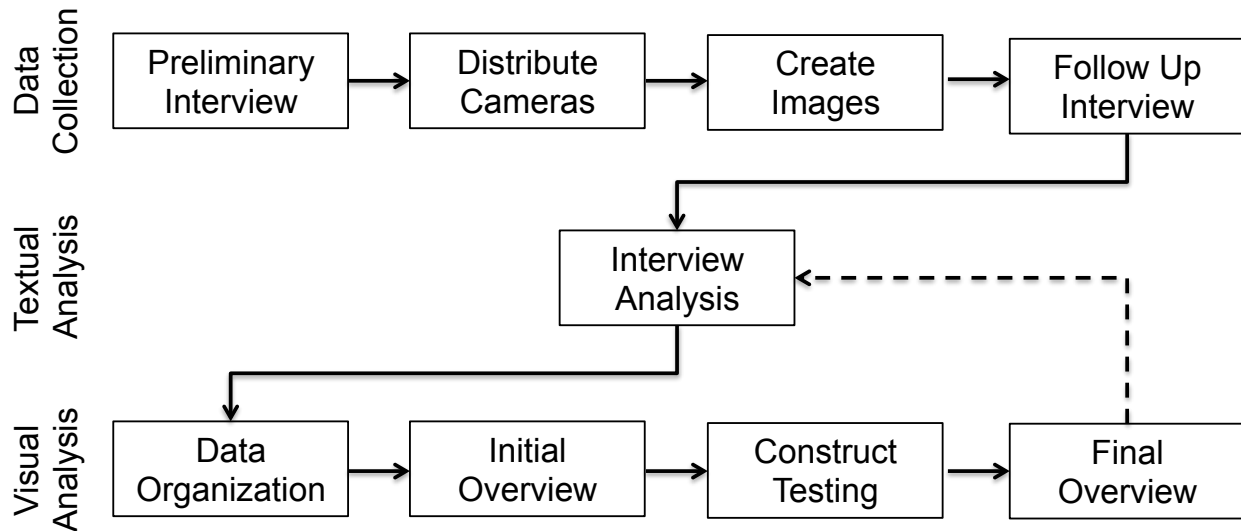
There is also a significant body of work regarding the experience of environmental health or environmental justice. For example, Kreuter et al. (2012) used a photographic methodology to look at perceptions of disparity in Atlanta. They find, for example, that priority issues for residents include construction debris and vacant housing. Redwood (2010), also working in Atlanta, uses photo elicitation to focus on the relationship between the built environment and negative health outcomes for urban populations. Similarly, Suchar and Rotenberg (1994) use it to investigate perceptions of housing adequacy in a Chicago neighborhood. In another example, Berrang-Ford (2012) discovers concerns about water supply while studying issues of indigenous health and climate change. While these and similar papers are not typically designed to focus on infrastructure, the relevance for researchers concerned with the built environment is easily apparent. Another body of work coming out of Australia uses visual methods to investigate issues in water policy, planning and sustainable development issues (Baldwin and Ross 2012; Keremane and McKay 2011).

THE PHOTO ELICITATION METHOD

This section provides a practical roadmap for undertaking the photo elicitation method, shown schematically in Figure 1. First, details on the data collection process are provided. Next, visual analysis procedures are detailed. Along with these discussions, Figures 2 and 3 provide a brief

snapshot of what the data collection and analysis process would look like for a sample research project in construction productivity.

FIGURE 1: PHOTO ELICITATION RESEARCH PROCESS



Data Collection

The following text presents a standard procedure for photo elicitation research, modified from Rose (2006), Collier and Collier (1986), and Jewitt and Leeuwen (2001). Next, Figure 2 shows this procedure for a sample data collection process for a research question dealing with construction productivity.

Preliminary Interview: Preliminary interviews may be conducted with participants. These interviews treat the research topics but do not themselves involve images. An underlying premise of photo elicitation is that images elicit more and different information than verbal or written interviews. The preliminary interview allows the researcher to capture the information that may best come from a verbal discussion.

Distribute Cameras: After the preliminary interview, cameras are distributed to participants along with guidelines for how many and what kind of pictures should be taken. Participants should also be trained on how to use and care for the cameras.

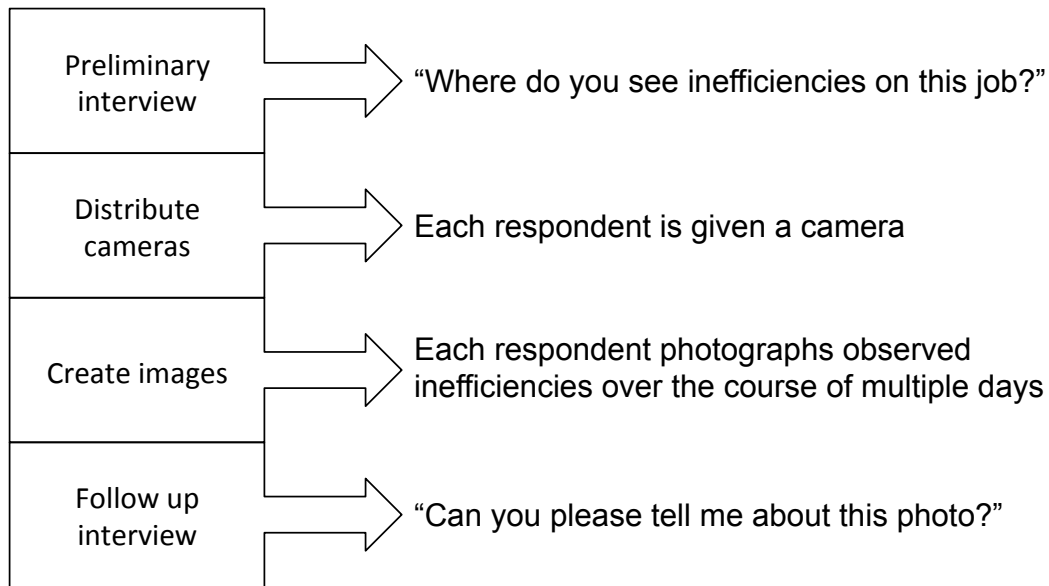
Create Images: After the cameras are distributed, the researcher leaves the context. Removal of the researcher from the research context may allow freer expression from participants and also less disruption from the presence of an outsider. This may be particularly valuable when dealing with vulnerable populations or sensitive topics. However, it cannot be assumed that the camera itself is a neutral object. For example, a study on highway traffic metering violations could be heavily impacted if drivers knew they were being photographed. Additionally, in some contexts cameras will be a relative novelty. This may mean that some people decline to participate due to discomfort with the technology, potentially biasing results.

In addition, the technology may be so highly visible in the community that it may not be possible to capture photographs where people are not aware they are being photographed.

It is suggested that photographs created for the research are taken on at least two different days in order to avoid bias created by an exceptional day. Additionally, if possible, it is recommended to ask participants to write thoughts or documentation about the photographs as they are taken in order to generate some written context and independent thinking before the researcher is injected back into the mix.

Follow Up Interview: After the photographs have been created, additional interviews are held with the photographers to discuss the photographs they have taken. Depending on the number of photographs taken and the time available for the interview, the researcher may have to pre-select photographs to discuss according to theoretical need.

FIGURE 2: DATA COLLECTION PROCESS FOR SAMPLE RESEARCH IN CONSTRUCTION PRODUCTIVITY



An important variation in the photo elicitation method is concerned with who provides the images that are used as prompts. In addition, we should note here that the images are not required to be photographs for this method to be successful; we could also use engineering drawings, 4D CAD, GIS, artistic representations, or videos as prompts. In some cases, images are either created by or provided by the researcher. The advantages of this variation are that it enables the researcher to structure the range of images used or topics treated in an effort to focus the research project, and also that data collection is faster than our second variation. The potential disadvantages of this method stem from the multiplicity of ways in which people may read images. In fact, in some instances, researchers have found that the images they selected did not resonate with respondents at all. As discussed in the literature review, Ray and Smith (2011) describe a project where this issue prevented productive data collection until participants began to suggest images they felt were more relevant to the research.

This study emphasizes the advantages of the second variation in data collection (shown in Figure 2 above) that asks participants to select or create images that represent the relevant research issues from their point of view. While this may mean that responses are particularly diverse, it also ensures that researcher preconceptions do not limit findings. This approach may increase equipment costs for the research, as cameras may have to be supplied to each respondent. This also means that respondents may be unfamiliar with the specific photographic equipment provided, and may need training to be able to operate it adequately. However, it is increasingly common for respondents to have cameras or telephones that are capable of taking photographs, and it may be possible to have respondents use their own equipment depending on the context. However, care must be taken as this may bias the results towards younger, richer, or more highly educated respondents.

Data Analysis

The following presents a basic model for visual analysis, modified from models presented in Collier and Collier (1986) and Jewitt and Leeuwen (2001). This process begins with unstructured analysis, moves to more formalized analysis, and then returns to a less structured approach that allows the researcher to return to the theory. Figure 3 below diagrams this process for the sample productivity research design described in Figure 2.

Sample Selection: As with any research project, a data set must be constructed in a manner appropriate to the ultimate claims the researcher hopes to make about her findings. This may include sampling from found images, the researcher taking photographs, or research participants taking photographs. In visual research like all other, datasets may range from large randomized samples to smaller, case-based sets that seek extreme examples of a particular occurrence. For the latter, sampling may mean that not all participant photographs are included in analysis. If this strategy is chosen, a clear method for selection should be presented in research write-ups. These choices must be described in detail in research reporting in order to define the relevance of the results.

Data Organization: Create a log and organizational for your images. Whether digital or physical prints, basic attribute data should be recorded for each image. What attribute data you will need is related to the research question of interest. This is a good opportunity to review the images you have collected and begin to understand the data. It is helpful to structure your organizational scheme in a way that is relevant to the research question you are asking. For example, if we are concerned with safety violations as a function of day of the week, we may want to organize images based on the day on which they were taken. Alternatively, if we are concerned with safety issues on high-rise building vs. road construction, we may want to sort the photographs based on where they were taken.

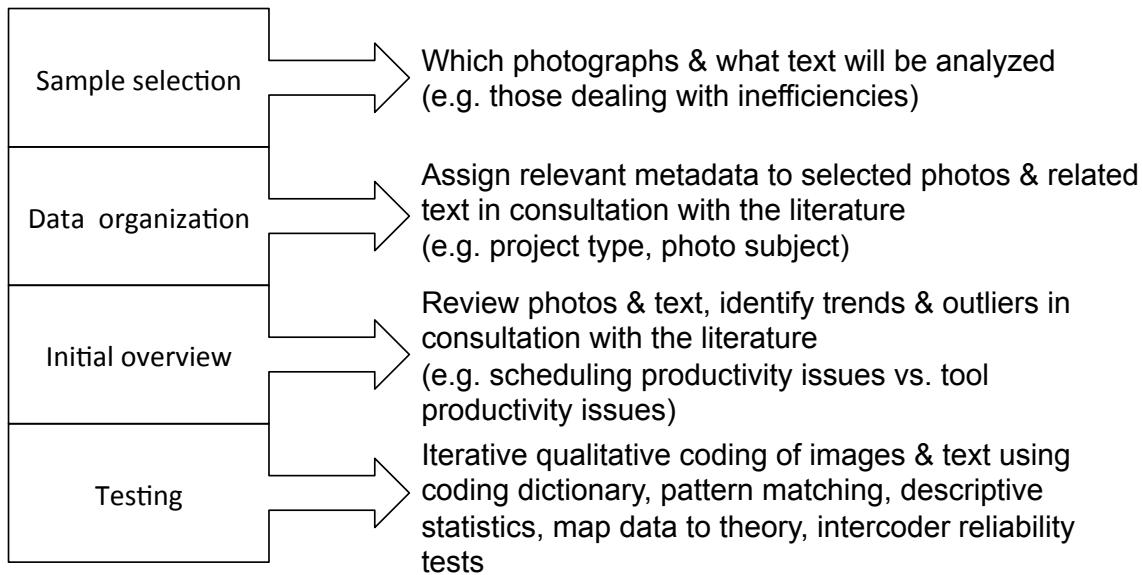
Initial Overview: The next step is to observe your data as a whole. It may help to print digital images so they can be sorted into various orders—for example, geographic, longitudinal, photographer—and seen at a glance. Alternatively, qualitative analysis software may be used to apply various organizational codes. This process is unstructured and should not be expected to

result in statistics or validated results. However, the researcher should write down any questions, impressions, trends, and outliers that seem to appear from the subjective review of the dataset, while carefully noting which photographs are related with these initial impressions. These research memos are a key part of any qualitative analysis procedure and may result in valuable insights to be rigorously evaluated later in the analysis process.

Testing: After the initial overview, you will have a starting point for more detailed analysis that can test insights as they relate to research questions. Content analysis or qualitative coding techniques may be particularly valuable for engineering researchers; however, other techniques such as semiology or discourse analysis may also provide valuable insight, especially though not only if the images were originally produced as representations of a firm or project (found images) rather than for the research project itself. Special care should be taken to iteratively develop and apply rigorous coding schemes that are exhaustive, mutually exclusive, and theoretically interesting. These schemes must be reliable before statistics are produced or the resulting numbers are useless. Additionally, these coding schemes should be written down in a coding dictionary such that any findings are reproducible by other researchers. This coding dictionary should be sufficiently detailed so that a researcher otherwise unaffiliated with the project could replicated coding, or that new images could be added to the dataset. It is good practice to perform intercoder reliability checks as part of any qualitative analysis. It may be particularly vital for visual research, as images may be read differently by different viewers. Here, a second researcher will independently attempt to apply the coding scheme to the images. Next, comparisons between the two researchers establish how often they applied the same or different codes; reliability of at less than 90% suggests serious problems with the coding scheme. This is particularly true for coding schemes with a small number of codes, where intercoder reliability should approach 100%.

Final Overview: At this stage, the researcher is thoroughly familiar with the images in the data set and has developed a number of descriptive statistics and comparisons. The final step in analysis is to return to a high level overview of the data. This enables the researcher to re-establish the context that explains the significance of and relationships between the details developed previously.

FIGURE 3: DATA ANALYSIS PROCESS FOR SAMPLE RESEARCH IN CONSTRUCTION PRODUCTIVITY



The general analysis process presented here may be applied in a large number of permutations as appropriate for a specific research question. However, there are two primary types of analysis that may be performed on photo elicitation datasets. The first is textual data collected about the images, like interview transcripts. The second is the visual data collected in the images themselves or in additional contextual data about the images that itself takes the form of an image. An example of the latter could be an engineering drawing provided to supplement understanding of a photograph of a construction site. Here we present a basic procedure for the analysis of visual data. Readers are referred elsewhere (for example, see Miles and Huberman 1994; Saldaña 2009; Singleton and Straits 2004) for the better-established textual data analysis techniques. Finally, it should be noted that a particular research project may analyze both text and images, or only one of these types of data. However, the visual analysis will be most valuable if the images are accompanied by at least some textual metadata, such as where, when, by whom, and for what purpose the image was created. For example, we might plan to study construction safety violations using photographs. We would expect safety practices to vary over time and by location; thus this information is critical to the analysis. Additionally, knowing who took the photo for what purpose will also yield valuable information; we would expect, for example, a construction image intended for marketing to studiously avoid any controversial topics such as safety violations.

RECOMMENDATIONS FOR APPLICATION TO ENGINEERING RESEARCH

Because of the late arrival of photo elicitation techniques to engineering research, there is the potential for leveraging past experience in other research traditions to develop methodological guidelines for the production of consistently high quality research. Ultimately, publications using visual methods must provide details of the research methodology. These

details define the level of reliability, generalizability, and rigor, which in turn affect how the results should be used and expanded in subsequent work. Much as poor statistical methodology can produce biased numbers, poor qualitative methods can also produce biased results. This article is intended to provide construction researchers with a clear description of photo elicitation methods and specific guidance as to how they can be applied to achieve high-quality research results. Here we offer some thoughts for this best practice.

Carefully Structure Data Collection

As with any research project, studies using visual methods must carefully consider the sampling scheme with regards to the research questions being asked. For example, visual methods could be used to collect data intended for statistical analysis, but must then use random sampling techniques, ensure adequate sample sizes, etc. Alternatively, when visual methods are employed in case study research, the method may be applied to a small number of purposefully selected typical or extreme cases. No matter the sampling scheme chosen, it should be thoroughly documented and included as part of any presentation of the research.

Specify the Source of Images

Papers should explicitly indicate the source of images used as prompts. If participants created or supplied the images, research reports should include a description of the equipment used, any training participants received, and any guidance that was given them regarding the purpose of the research project. If participants are instead asked to supply found images, the sources of these images should be documented.

Specify Data Analysis Procedures

Papers should specify if analysis was done on just text, just images, or a combination. If only images were analyzed, the researcher must meet the burden of proof in explaining why the interpretations they gave the images should be accepted as important or definitive. If purely visual analysis is performed on participant created images (and ideally with any analysis), the results should be presented to the participants before publication in order to see if they agree with the findings. It is further possible that the researcher will feel her own perspective is important to report even if it disagrees with the research participants; in this case, the source of the disagreement and an explanation should be provided.

Meeting the Burden of Proof

While it is possible that visual methods will be used in large, survey-esque designs intended to create quantitative data, it is likely that they will typically be used in qualitative research projects. In qualitative research, detailed case knowledge should be developed and applied to analysis. To document this, data collection and research design methods must be carefully documented as in any other case based research. For example, this should include standard methods to ensure the validity and reliability of the research (Taylor et al. 2011). As described above, coding dictionaries and intercoder reliability are important tools to ensure

reliability and generalizability. Depending on confidentiality agreements, publishing some of the images may also help to communicate the results. Representative quotes from interviews may be useful in communicating results, and counts of how often codes appeared help describe the limits of generalizability. As with most qualitative research, analytic generalizability (Eisenhart 2009) driven by theory is the goal.

ADVANTAGES & LIMITATIONS

A great advantage of photo elicitation methods is the relatively low equipment investment required. Over the past decade, inexpensive, small and durable cameras appropriate for the job site have become increasingly available. As of the date of writing, disposable film cameras can be purchased for less than \$10 USD each, while reusable digital cameras are about \$100 USD. Digital cameras are especially useful for simple and near instantaneous data sharing when researchers or sites are geographically dispersed. Digital images (whether created digitally or scanned to this format) also have the advantage of easy import into most of the many available excellent qualitative coding software packages.

In addition, automated settings on point and shoot cameras make it possible for research participants with virtually no experience with personal electronics to successfully participate in the research process. This means that the method is significantly more inclusive than those that require the use of written means of communication or even the use of a dominant language. As education globally privileges males (UN 2011), this suggests that photo elicitation may be more gender-neutral than more traditional techniques, especially if time is taken to properly train all participants on technology use (again noting a global male bias towards control of technology). If participants take photographs, this method also removes the researcher from the immediate research context. This can be a valuable attribute while working with disadvantaged, abused, or socially different respondents. Research has shown that there is a measurable liability of foreignness (Zaheer 1995) and that lack of homophily between researcher and respondent can impact research findings (Rogers 2003).

Visual methods may also help avoid issues of free recall (Singleton and Straits 2004). In interview research methods, respondents must remember examples in response to researcher prompts. If a respondent does not think of an example, or selects one example to communicate while neglecting others, bias is introduced into the collected data. In contrast, if respondents carry cameras with them they can capture images as they occur, leaving a record of each instance. In addition, photo elicitation methods can avoid the need for respondent training in understanding and responding to interview questions. When participants are invited to take and explain photos themselves, the researcher gains rich data and can more easily identify and exclude instances where respondents did not understand the research premise. This is a significant advantage over survey techniques where, for example, respondents may choose an answer at random rather than admit they do not understand a poorly worded or otherwise inappropriate question.

Finally, construction and engineering researchers can benefit from a well-established body of knowledge from other research traditions. Learning new tools from other disciplines is a

venerable tradition in construction research, which is after all a relatively young discipline (Levitt 2007). This great advantage means that proven and validated methods can be applied to construction questions in an efficient manner.

Of course, photo elicitation methodology also has significant disadvantages. It is limited to the investigation of social phenomenon in construction, though its near neighbor photo documentation may serve for other types of inquiry. In addition, visual images may be read differently by different people (Banks 2001). This may mean that researcher-selected images may not communicate what they are intended, or that researchers misinterpret participant created images. While this limitation may be avoided somewhat by subsequent interviews and discussion, a purely image-based analysis does not enjoy this luxury.

While photographic methods can partially remove the researcher from the research site, we should not assume that physical absence during photographic activities means the subjects do not feel the foreignness of the research activity or even of the camera itself (Pink 2006 p. 36). Generally, researchers should not assume that visual methods will be immediately appropriate to a particular context and research schedule. Without a high level of trust, people may be unwilling to be photographed or to take photographs. In addition, in certain contexts, printed photographs are luxury status items. Access to photographic technologies, while becoming more universal through the spread of cellular telephones, is also an item that may emphasize economic disparity between researcher and informant. The implications this has for the research at hand must be considered (Pink 2006 p. 32).

Finally, it is important to recognize that informants have their own agendas, motivations, and narratives for the scenes they live in. Further, they have expectations about what sort of images they think the researcher wants or should want to acquire. This issue is similar to interview methods in that people may answer questions with the answer they think they are supposed to give. While this does indeed shape the answers or images we may produce as part of any research project, it is not necessarily a negative impact. Any representation of reality is necessarily limited simply because it is a representation. By recognizing this in our analysis of images or indeed interview data, we can gain a more nuanced view of the knowledge and worldview of our informant. We gain knowledge of the way the informant feels things ought to be, based on her own perception of what is important, what an outsider can be expected to understand, and how the informant wants to represent her own identity. This does not mean we should abandon these methods, but rather that we must carefully consider the research questions they are appropriate for, and also the implications this has for analysis.

ETHICAL ISSUES WITH VISUAL RESEARCH

Any research project involving people potentially has ethical implications. Photographic methods are certainly included in this. If construction sites or other workplaces are the subject of interest, it is possible that confidentiality or anonymity will be required by the responsible firms regardless of whether or not the photographs include people. If the subject of the photograph can be identified by knowledgeable others, their release could potentially cause negative impacts for

participants or their organizations. In these cases, it may not be appropriate for the research team to share images as part of publications. Researchers must develop and abide by written confidentiality or release plans. Consent should be considered on a variety of different levels; the organization the individual is a part of in the particular research context, individual consent to participate in the research project, and an additional level of consent if photographs are to be shown to others outside of the research team. This last factor must not be conflated with consent for participation in the project.

In addition to issues of confidentiality, if participants have taken photographs they own the copyright to those images. Before images can be reproduced or published, researchers must obtain permission from the copyright holder. As copyright is a legal term governed by various laws internationally, researchers are encouraged to consult regulations both where they and the photographers are located. Whether or not participants give their permission for reproduction of the images, the researcher should consider giving the photographers copies of the images they take. It would seem appropriate that the participants should be able to see the images before they agree to have them published; as such the follow up interview that uses the photographs as prompts is a logical time and place to gather this permission.

Photo elicitation is often used as a participatory research method that is intended to motivate research participants to identify things they would like to change in their world. For these projects strong consideration should be given to having resources available to help achieve these objectives.

Finally, any photographic project must be aware of the issue of secondary research subjects; that is, people who are not enrolled in the project but who are photographed as part of it. For example, photographs of a bicycle path may include pictures of local cyclists who happen to be using the path at the time. Local regulations regarding human research and privacy must be consulted, but generally if people are in a public place, there is minimal or no risk to them, and it will not adversely affect their rights or welfare it may be acceptable to take these images as part of a research project. Researchers are encouraged to contact local human subject research boards for specific guidance. As part of this caution, it is strongly recommended that photographers be instructed in how to delete photographs should they be requested to. Finally, Prins (2010) notes that photographic methods have contradictory potential for gaining knowledge of marginalized groups' knowledge but also for social control of these groups. These serious charges must be considered as part of any research project.

CONCLUSION

This paper describes a method, advantages, limitations, and potential ethical issues of concern for photo elicitation in engineering and construction research. Although photo elicitation has not yet been rigorously applied in our field, it provides a promising technique for researchers interested in understanding the perspective of others. More generally, in this paper I claim that both the direct analysis of visual artifacts and also the use of those artifacts as interview prompts can improve engineering research. While in this paper I focus on photo

elicitation, which is new to construction research, my more general claim of the utility of visual methods also encompasses other visual representations of the visible such as VR, GIS, and CAD. These tools are commonly used to improve construction projects; I claim they should also be commonly (if differently) used to improve construction research treating topics otherwise unrelated to visualization. Our research community is well placed to benefit from the knowledge and experience of other disciplines as we discover the potential of this new research tool. This is vital for including human factors in the design and construction of infrastructure projects that, due to their scale and ubiquity, have a large impact on the daily lives of the people they are built for.

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