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# The Internet and Digital Imaging: A Recipe for Visual Deception

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## ABSTRACT

This paper examines the role of photographs in visual communication and investigates the negative impact of digital technologies on veracity of photographic images. The Internet's facility of uncensored publishing highlights the concern in the ethics of digital imaging and namely the undisclosed digital manipulation of photographic content. A survey conducted on three different sample groups found that the correct identification of manipulated features is extremely difficult and largely depends on the level of expertise in the field of digital imaging. The most problematic manipulation technique to identify was deletion, achieving an overall 2.71% accuracy. As digital technologies allow for easier content creation, alteration and distribution, the authors challenge the traditional believability in photographic evidence and propose investigation into the feasibility of implementing visual interpretation methods into broad education.

## VISUAL INFORMATION AND PHOTOGRAPHS

Society relies heavily on photographic images to convey messages, information and to assist in understanding reality (Coleman, 1998). The wide proliferation of photographs online has the capacity to create global exposure on all social levels (Harris, 1995).When photographs from a war zone can lead to peace negotiations and imagery of malnourishment in third world countries instigate humanitarian aids, the effect of visual information on 'society's consciousness' is rather evident (Harris, 1995).

While early photography was perceived as capable of reproducing accurate portraits of reality, it was simultaneously embraced by some as a tool for artistic expression (Wells, 2000). Nonetheless the worlds of realism and art in the nineteenth century seemed to remain separate as photographic alterations by artists were not aimed to mislead viewers but to invoke imaginary worlds, dreams and fantasy (Wheeler, 2000). However, the advent of digital imaging has seemed to blur the distinction between reality and art, creating ethical issues of credibility and trust in photographic evidence. Undisclosed digital alteration of photographic content can indeed be regarded as 'manipulating the public' (Tilman and Hollstein, 1996:55).

## WHY ARE PHOTOGRAPHS BELIEVED?

Photographic images contribute to persuasive communication on a number of levels. Firstly, visual communication supports right-brain processing and consequently tends to avoid the left hemisphere associated with logic and reason (Coleman, 1998). The right side of a brain views pictures as a whole rather than analyzing their smaller parts. It is a center for creativity, imagination and emotional responses (Science Weekly, 1995). In addition, the right brain is far more mature over its left hemisphere and has a unique ability to instantly compare images (Shlain, 1998). Although both hemispheres are capable of communicating with each other, the increasing amount of visual communication may inevitably lead to the development of right-brain processing over its logical opposite (Coleman, 1998). In addition, photographs can form subliminal perception when thoughts and feelings are generated by stimuli without any awareness of this process (Merikle, 2000). Perhaps the most special characteristic of a photograph is its ability to generate an immediate emotional response (Freund, 1980). Subsequently, such an emotional response is closely associated with believability in the photographic content (Harris, 1995).

Supporting the significance of visual perception are research findings that 75 percent of information enters the brain through the eyes (Hanson, 1987) cited in Berger (1989). The tradition of believability appears to be derived from news photographs, known for their strong communication and contextualization capabilities (Harris, 1995). While verbal grammar received towering attention shortly after Gutenberg invented the printing press, educators never seemed to give the same consideration to a 'visual grammar for photographs' after the invention of film photography (Lester, 2003:viii). By living in a 'visually intensive society' where stimulation by images is intervening with the written word (Lester, 2003:viii), the requirement for an authentication process of photographic veracity is even more important.

## DIGITAL TOOLS, MANIPULATION AND ETHICS

While early manipulation of photographs through chemical processes was detectable, the advent of digital technology seems to have altered the original relationship between photographs and subject matter. Digital technology now allows not only for easier content distribution but opens far more opportunities for photographs to be misused (Coleman, 1998). Software packages such as Adobe Photoshop are capable of effective, seamless digital alteration and can thus produce convincing results of visual misinformation. According to Coleman (1998) it is possible to manufacture any photographic evidence with the help of digital technology.

A detailed overview of manipulation techniques is provided by Messaris (1997) and Brugioni (1999). However, it needs to be clarified that certain kinds of photographic manipulation such as photographic staging (imitating reality), mislabeling (misleading captions) and sequence editing (omitting or reversing) have existed since the birth of photography. However, the most common types of *photo fakery* associated with the power of computer processing and specialized software are deletion of details, insertion of details, photomontage and a change of physical appearance.

Also known as effacement, deletion became famous in the political propaganda of communist governments, eliminating from photographs those who had become politically inconvenient (Mitchell, 1994). Today, famous beneficiaries of this technique are magazine celebrities, whose waist lines are altered and apparent signs of aging removed with the help of digital imaging (Brugioni, 1999). Similarly to deletion, insertion of additional details to an existing photographs results in an image that represents only a partial truth.

Although the increasing awareness of manipulation techniques is frequently associated with predictions of loss of trust in photography, it is yet to be proved that the use of photographs will decline. In contrast to photojournalism or news production, most individuals publishing visual content on the Internet are not required to follow any set of

ethical guidelines. Although still in its infancy in comparison to other types of communication media, the Internet is considered as one of the main sources of information by the majority of its users (Lebo, 2003). Studies of the importance of the Internet as an information source provide evidence of the Internet's prime role in information seeking (Lebo, 2003). Over the past fifteen years, the Internet has grown from a previously text-based medium into a source of visual information. At the same time, the decentralized architecture of the Internet and its unique facilitation of uncensored publishing have shaped this expansive network into a dangerous realm of mistrust and deception.

One of the major concerns in the ethics of digital imaging is how its believability can lead to visual deception (Brugioni, 1999). In the age of digital photography where the negative is no longer a source of authentication and images are formed merely by binary code, falsification of photographic content appears to be prolific. The main concern that arises in this area is whether the digital manipulation of photographs distributed over the Internet can be commonly recognized with the naked eye. Although authentication processes using watermarking techniques or Public Key Infrastructure (PKI) have been developed and tried, it may be argued that such authentication methods relying on complex algorithms and costly technology are not yet widely available to the general public.

The possibility of seamless manipulation certainly challenges one's faith in photography in regards to its evidence of reality. Since the arrival of digital imaging technology, this concern has become very prominent with media critics, especially since there seem to be no widely implemented standards to protect viewers from accepting visual misinformation as true. Manipulated photographs lacking disclosure should be regarded as deceptive.

## RESEARCH DESIGN

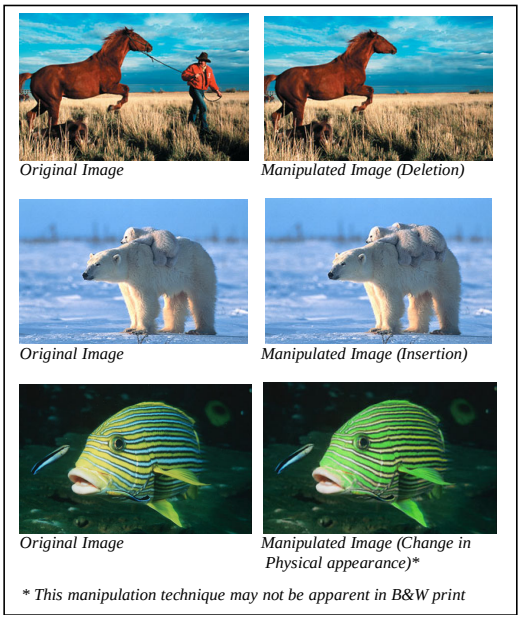
The focal area of the author's investigation was the level of the ability to identify features of digital manipulation performed on photographs. The objective of this survey research was to collect quantitative and qualitative data pertaining to the discernment of digital manipulation techniques. By triangulating sources, the author aimed to observe whether the ability to differentiate between original and digitally manipulated photographs varied across three different groups based on their assumed knowledge and experience with digital imagining. Furthermore, analysis and interpretation of this data provided an insight into what percentage of each defined target population is capable of correctly detecting photographic manipulation, the accuracy in distinguishing between original and manipulated images and lastly, what various clues or characteristics of a photograph each sample group ranked the highest in assisting them to identify photographic deception.

The research subjects had an assortment of knowledge and experience with digital photo manipulation created the basis for a cross-sectional study, allowing sampling of participants from different backgrounds. The skill-set and knowledge of digital photo imaging constituted the first and foremost defining characteristic of each classification of group membership. The geographic boundaries of each population were set within Australia. No further identification of socio-demographic characteristics was collected. Due to resource limitations, sample statistics were used to represent the actual population parameter.

The first group (Group 1, n=45) of participants representing no or minimal knowledge of digital imaging was sampled from students enrolled at Monash University, with the exclusion of the Faculty of Information Technology. The second group (Group 2, n=63) was comprised of students from the School of Multimedia Systems under the Faculty of IT, assuming their closer proximity to the field of digital imaging based on the school's curriculum. The third group (Group 3, n=12) representing experts, was sampled from a population of Australian businesses specializing in photographic processing.

The survey design consisted of a printed questionnaire and a self-contained electronic application. The questionnaire contained a checklist of two mutually exclusive and collectively exhaustive categories

*Figure 1.1. Examples of manipulation techniques (2005, National Geographic Society)*




(true vs. false) for each question. The electronic application created in Macromedia Flash included a series of sixteen photographs. The original photographs were obtained from the galleries of The National Geographic Society (NGS) along with a statement that no manipulation was previously performed on the photographs with the exception of cropping or resizing. Fifty percent of these photographs were then digitally manipulated using techniques such as insertion, deletion and change in physical appearance (see Figure 1.1 below).

The participants were provided with a concise definition of digital manipulation, relative to the research. A subsequent measure was incorporated in the survey design in order to validate True vs. False answers by requiring participants to further state what features of each manipulated photograph they perceived as digitally altered. Implementation of such a supplementary qualifier aimed to eliminate guesswork among True vs. False answers and to arrive at research findings indicating whether it is possible to correctly identify the manipulated details of a photographic image.

## RESULTS

True and False answers were assigned a nominal scale of 1 and 0 (1 = manipulated, 0 = original). A binomial experiment counting the number of correct answers among all True vs. False questions reported an overall accuracy of 39.51% in distinguishing original photographs from their manipulated counterparts.

Table 1.1 further shows that in calculating averages of correct answers based on the True vs. False paradigm, Group 3 (Experts) demonstrated the best ability. The accuracy of Group 3 reached 54.86%, followed by Group 2 scoring an overall 41.93%. Group 1 (non-Multimedia Students) returned the lowest average in recognizing manipulated images at 32.04%.

In implementing a subsequent measure to validate True vs. False answers by identifying specific manipulated features, the overall accuracy dropped to 9.79% (see Table 1.2). In addition, Group 1 (non-Multimedia students) reported zero ability to recognize manipulated features on photographic images utilizing the deletion technique, overall averaging a mere 5.93%. Group 2 (Multimedia Students) distinguished manipulated features in 11.11% of instances while Group 3 (Experts) demonstrated the highest ability by achieving an overall 17.36% accuracy.

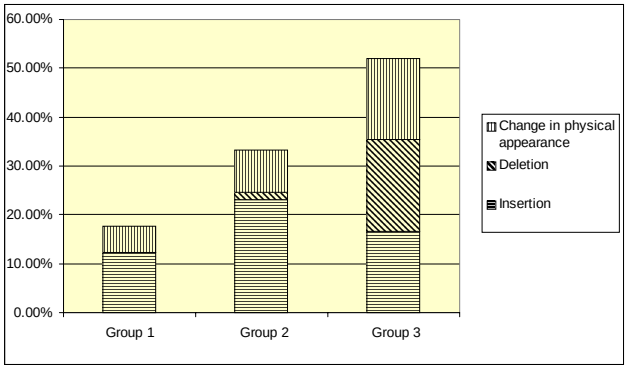
*Table 1.1. Recognition of manipulated photographs based on a True vs. False paradigm*

| MANIPULATION TECHNIQUE | Group 1, n=45 | | Group 2, n=63 | | Group 3, n=12 | | Total n=120 | |
|---|---|---|---|---|---|---|---|---|
| | *n* | % | *n* | % | *n* | % | ***n*** | **%** |
| change in physical appearance | 17 | 37.78% | 39.5 | 62.70% | 6.5 | 54.17% | 63/120 | 52.50% |
| deletion | 14.3 | 31.67% | 26.8 | 42.46% | 6.75 | 56.25% | 47.75/120 | 39.79% |
| insertion | 12 | 26.67% | 13 | 20.63% | 6.5 | 54.17% | 31.5/120 | 26.25% |
| **AVERAGE** | | **32.04%** | | **41.93%** | | **54.86%** | | **39.51%** |

*Table 1.2. Recognition of manipulated features*

| MANIPULATION TECHNIQUE | Group 1, n=45 | | Group 2, n=63 | | Group 3, n=12 | | Total n=120 | |
|---|---|---|---|---|---|---|---|---|
| | *n* | % | *n* | % | *n* | % | ***n*** | **%** |
| change in physical appearance | 5.5 | 12.22% | 14.5 | 23.02% | 2 | 16.67% | 22/120 | 18.33% |
| deletion | 0 | 0.00% | 1 | 1.59% | 2.25 | 18.75% | 3.25/120 | 2.71% |
| insertion | 2.5 | 5.56% | 5.5 | 8.73% | 2 | 16.67% | 10/120 | 8.33% |
| **AVERAGE** | | **5.93%** | | **11.11%** | | **17.36%** | | **9.79%** |

*Figure 1.2. The overall accuracy increase based on assumed level of groups' expertise*




*By averaging the correct answers across all three target groups, it was observed that the most frequently recognized manipulation technique was 'change in physical appearance' at 18.33%, followed by 'insertion' (8.33%) and 'deletion' (2.71%).*

The linear relationship of the averaged results based on the assumed level of each group's expertise in digital imaging is illustrated in Figure 1.2.

In the feedback provided by the participants in regards to the process of discerning between original and manipulated photographic images, Group 1 (non-Multimedia students) ranked "realistic look" the highest, followed by "colour", "intuition" and "common sense". Group 2 considered "colour" as the leading factor, followed by an equal score between "lighting" and "shadows". The realistic look was the fourth factor assisting Group 2 in the process. Lastly, Group 3 (Experts) regarded "pixels" and "lighting" as the foremost attributes in detecting manipulated features. Additionally, Group 3 reported factors such as "sharpness", "composition" and "signs of cloning". In contrast to Group 1 and 2, in no cases did Experts rely on realistic look, common sense or intuition. The assessment criteria, to which Group 3 predominantly referred, was technical.

Due to different sample sizes in each group, Single Factor ANOVA analyses were conducted on correct answers to manipulated photographs in order to test for equal means across the three target groups. This test showed that there is a significant difference in the level of recognition of manipulated images between sample groups was verified in five out of eight cases.

## DISCUSSION

The research survey examined the level of people's ability to distinguish between original and digitally manipulated photographs as well as their accuracy to identify specific manipulated features. Findings of this cross-sectional study, using three target groups with different proximity to the field of digital imaging, showed that experts in photographic processing (Group 3) are the most capable in discerning between manipulated and original photographic images as well as identifying specific manipulated features. They were followed by multimedia students (Group 2) and lastly by students not enrolled in Multimedia studies (Group 1). This pattern indicates that the level of one's ability to recognize digital manipulation of photographic images may be directly influenced by the level of skill and experience in the field of digital imaging. Potentially representing the largest population of regular Internet users, Group 1 has demonstrated the lowest level of ability to recognize photographic manipulation, by reaching 32.04% accuracy based on True vs. False paradigm and 5.93% in identifying the actual manipulated features of presented photographs.

Division of averaged results across three distinct manipulation techniques enabled evaluation of each group's ability based on the individual manipulation technique. Findings of this analysis showed that Group 1 was unable to identify manipulated features on any photograph utilizing the deletion technique. Followed by Group 2 at 1.59% and Group 3 at 18.75%, deletion proved to be the most problematic manipulation technique to delineate. This finding reinforces Mitchell's (1994:200) observation pertaining to the technique of deletion that absence of objects in a photograph becomes evident only when it 'conflicts with our presuppositions'. It should be considered that unless achieved through a meticulous analysis of pixel structure, the identification of deleted details emerging from this survey may have been a result of auspicious guesswork.

The most accurate identification of manipulated features achieved by Group 1 and Group 2 were observed in colour adjusted photographs utilizing a technique 'change in physical appearance'. This finding supports the analysis of commentaries provided by these groups, according to which colour represented one of the two foremost factors in their identification process of manipulated features. In contrast, Group 3 (Experts) were the most successful in detecting the insertion and deletion technique, which corresponds with their feedback that pixels, lights and shading provided them with the best evidence of digital manipulation. This observation further confirms that knowledge of techniques applicable to digital imaging does contribute to one's ability to correctly identify photographic manipulation.

In one occurrence, both Group 1 and 2 displayed a higher capacity than Group 3 in identifying manipulation technique of a photograph categorized under 'change in physical appearance'. By altering hues and saturations, original colours of a chosen subject in this particular photograph were replaced and intensified. A likely explanation of why experts failed to better identify this manipulation technique may be found in the analysis of commentaries provided by survey participants. When evaluating what assisted each group in the overall discernment process, both groups of students referred to colour as one of their top two identifiers of digital manipulation. Perhaps understanding the subjective nature of colour perception, Experts did not refer to this characteristic at all and considered pixels and lights instead as the two most important factors. Another possible justification why this particular photograph was more correctly identified as manipulated by Group 1 and Group 2 is their documented observation of a 'realistic look'. While participants of both groups displayed certain predispositions to judge the likelihood of the authenticity of photographic content based on whether the photograph 'looks real', Experts did not demonstrate such a tendency. This observation confirms Wheeler's (2002) remarks that trust in photography is most commonly linked to the way photo-

graphs portray reality. However, as the perception of reality is highly subjective, it may be argued that the reason for a higher accuracy achieved by professionals in photographic processing seems to be derived from their rational, scientific approach. However, the additional advantage of Group 3 when compared to the rest of the participants may also be found in their professional knowledge of camera equipment and an understanding of the effects that can be accomplished by various filters and lenses rather than pure digital alteration.

Results of the survey indicate that relying on factors such as a 'realistic look' and 'intuition' does not lead to correct identification of visual deception. Group 1's considerably low level of ability to distinguish photographic manipulation presents a concern as this target group is potentially representing the largest proportion of population. The findings of this study lend the suggestion for interpretation methods of photographic content along with basic principles of digital imaging to be included in compulsory education.

## LIMITATIONS AND FURTHER RESEARCH

The recruitment of Group 1 and 2 survey participants was limited to students of Monash University in Australia, therefore no generalizations of research findings can be made. The presuppositions formed by the participants about the study that a proportion of photographs would be digitally manipulated, may have affected survey results.

## CONCLUSION

Results of the survey conducted on Monash university students and Australian businesses specializing in photographic processing provided a deeper insight into understanding one's ability to recognize digital manipulation performed on photographic images. The findings revealed a pattern indicating that the ability to recognize digital manipulation is related to one's knowledge and skill-set in the field of digital imaging. While generalizations cannot be implied, the results pointed to the extreme difficulty to accurately identify manipulated features of photographic images. It was also observed that varying levels of discernment of manipulated features were associated with different manipulation techniques. The identification of deleted details from photographs proved to be an impossible task for the sample group comprising of students with no background in multimedia or digital imaging, potentially representing a large percentage of regular Internet users. A more successful rate was achieved by the two groups of students in recognizing colour adjusted details. However, hues and saturations do not tend to significantly alter the content of a photograph in comparison to deletion or insertion techniques.

This is a small study however it reinforced the exigency to raise the necessary awareness pertaining to credibility and trustworthiness of photographic content. It may be argued that authentication methods relying on complex algorithms and costly technology are not yet widely available to the general public, thus leaving readers to rely on their common sense when evaluating the veracity of photographs. It may be therefore advisable that visual grammar for photographs be developed and interpretation methods of visual content included in broader education to protect future generations from being misled by fraudulent digital imagery.

## REFERENCES

Berger, A. A. (1989). Seeing is believing: an introduction to visual communication. Mountain View, Calif., Mayfield Pub. Co.

Brugioni, D. A. (1999). Photo fakery: a history of deception and manipulation. Washington, D.C., Brassey's.

Coleman, A. D. (1998). The Digital Evolution: Visual Communication in the Electronic Age: essays, lectures and interviews 1967-1998. Tucson, AZ, Nazraeli Press.

Freund, G. (1980). Photography & society. Boston, D. R. Godine.

Harris, C., R., Ed. (2002). Photographic perception: The Myth of the Thousand Words. A Guide for New Media Professionals. Boston, Allyn&Bacon.

Lebo, H. (2003). The UCLA Internet Report: Surveying the Digital Future. M. Dunahee. Los Angeles, CA, UCLA Center for Communication Policy.

Lester, P. M. (2003). Visual communication: images with messages. Australia; United Kingdom, Wadsworth.

Merikle, P., M. (2000). Subliminal Perception. Encyclopedia of Psychology. A. Kazdin, E. New York, Oxford University Press. Vol. 7: 497-499.

Mitchell, W. J. (1994). The Reconfigured Eye: Visual Truth in the Post-Photographic Era. Cambridge, MIT Press.

Science Weekly (1995). Left brain/right brain: functions of the parts of the brain. 10/11/1995, Science Weekly.

Tilman, B., Hollstein, M. (1996). "Journalism Faces a Serious Technological Threat." Journal of Undergraduate Research Vol. 7(No. 1): 51-58.

Shlain, L. (1998). The Alphabet versus the Goddess: The Conflict Between Word and Image. London, Viking/Penguin.

Wells, L., Ed. (2000). Photography: A Critical Introduction. London, UK, Routledge.

Wheeler, T. (2002). Phototruth or Photofiction: Ethics and Media Imagery in the Digital Age. Mahwah, N.J, Lawrence Erlbaum Associates.