

Image, Appearance and Vanity in the Use of Media Spaces and Videoconference Systems

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ABSTRACT

Media spaces and videoconference systems are beneficial for connecting separated co-workers and providing rich contextual information. However, image sharing communication tools may also touch on sensitive spots of the human psyche related to personal, perceived image issues (e.g., appearance, self-image, self-presentation and vanity). We conducted two user studies to examine the impact of self-image concerns on the use of media spaces and videoconference systems. Our results suggest that personal, perceived image concerns have a considerable impact on the comfort level of users and may hinder effective communication [8]. We also found that image filtering techniques can help users feel more comfortable. Our results revealed that distortion filters, which are frequently cited to help preserve privacy, do not tend to be the ones preferred by users. Instead, users seemed to favor filters that make subtle changes to their appearance, or, in some instances, they preferred to use a surrogate instead.

Categories and Subject Descriptors

H.4.3 [Information Systems Applications]: Communications Applications – Computer conferencing, teleconferencing, and videoconferencing; H.5.2 [Information Interfaces and Presentation]: User-interfaces – screen design, user-centered design.

General Terms

Experimentation, Human Factors.

Keywords

Image, vanity, self-presentation, privacy, media space, videoconference, telepresence, appearance, image filter.

1. INTRODUCTION

Media space and videoconferencing tools can enhance organizational communication by connecting geographically dispersed co-workers, providing awareness through rich contextual information, and improving users' sense of presence [8]. However, current use of media spaces and videoconferencing systems is much less than was previously predicted by the plethora of research and development in the mid 1980's and early 1990's [2]. Privacy has been recognized as a key barrier to the adoption of media spaces and teleconferencing systems and privacy concerns (e.g., autonomy, solitude, confidentiality [7]) have been explored from a variety of perspectives [4, 5, 7, 18, 19, 24, 35, 36]. However, very little research has examined how issues of vanity, or concern for one's appearance, impacts users comfort with image sharing communication.

The goal of this work was to investigate whether users are concerned about issues of appearance and vanity when interacting in media spaces or videoconferencing sessions. Two studies were conducted to better understand factors related to image consciousness and sharing and how these factors influence image based communication. Our results demonstrate that users want to be able to see their self-image, but are concerned about their appearance, and that vanity issues can cause distraction and discomfort in image sharing communication.

We also explored the potential of image filtering techniques to help make users more comfortable with the images they share. Our results revealed that some frequently cited image filtering techniques (e.g., distortion filters), were viewed less favorably than techniques which only slightly modified users' appearances without causing a high degree of distortion. Users were also interested in the possibility of using a surrogate or avatar instead of their own image.

2. RELATED WORK

2.1 Image Sharing Communication

Experimentation with image sharing communication systems dates back to the 1920s when Bell Labs was exploring televisions to provide a 'face-to-face' addition to a telephone conversation [25]. In the late 1960s, AT&T released their PicturePhone system, which was one of many visual telecommunication systems introduced to enhance communication. Although the PicturePhone garnering a great deal of interest; it ultimately failed in the marketplace.

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In the mid 1980's and early 1990's there was an explosion of media space research and development. The motivation for this work was to find ways to allow physically separated colleagues to work together effectively and naturally with a better sense of presence. In addition, researchers wanted to support informal communication in the workplace to coordinate social and work activities and provide general awareness information. Several systems were developed and deployed during this time, including VideoWindow [13], EuroPARC's RAVE [15], Portholes [10], CRUISER [12] and CaveCat [23]. More recently, Boyle and Greenberg [7] categorized the different design possibilities for media spaces which included:

- Snapshot-only video portholes showing occasionally-updated small pictures;
- Intermittently open links between personal offices;
- Persistently open links between common areas (e.g., cafeterias, lounges);
- Video-as-data uses, where video provides access to a shared visual workspace.

Despite the intense interest in media spaces, very few systems are in use today [2]. Two key factors commonly associated with the apparent lack of success of media spaces are technology limitations and privacy concerns.

Although there have been many technological advances since the first media space systems were introduced, there are still technological barriers to be overcome. Baecker [2] points out several examples, including the unreliability of voice over Internet Protocol (VoIP), the lack of a significant deployment of innovative hardware designed to enhance the sense of presence, and the only partial integration of task space and interpersonal technologies. Boyle [5] affirms that video media space nodes and links are costly to install and operate and that network bandwidth could be seen as the principal constraint on the cost-efficient scalability of video media. He also discusses the limitations of factors such as image size, field of view, resolution, and compression quality as well as audio factors such as echo and sound levels.

Privacy concerns related to media spaces have been explored by many researchers. Gaver et al., [15] describe four dimensions of privacy that users need (or want) when using media spaces, including: control over who can see and hear them; information about the intention behind a connection; knowledge about when someone is seeing or hearing them; and avoidance of distractions which intrude on work. Patil and Kobsa [27] define privacy concerns along three main dimensions: who, when & where, and what. The who dimension describes who can access information, the when & where dimension describes one's availability to be accessed and likewise to access others, and the what dimension concerns what content should or shouldn't be accessed. Boyle and Greenberg [7] analyzed privacy concerns in media spaces from a variety of theoretical frameworks such as Altman's theory of privacy, in order to define a vocabulary applicable for CSCW research. Their framework decomposes privacy across three different modalities:

- Solitude: control over one's interpersonal interactions;
- Confidentiality: control over other's access to information about oneself, especially the fidelity of such access;

- Autonomy: control over the observable manifestations of the self, such as action, appearance, impression and identity.

According to [7], many problems related to privacy in video media spaces can be blamed on poor support for managing or controlling behavior, identity and impressions. Bellotti [3] also stresses the importance of considering how we enable people to present themselves appropriately in computer mediated communication (CMC). According to her there is a direct relation between control over self-presentation and privacy. Based on this work she presented a framework for addressing the design of control and feedback of information in computer communication environments. We also want to expand the concept of autonomy presented by [7], to not only cover media spaces but other image sharing communication and analyze image issues such as image consciousness, issues around sharing one's appearance, self-presentation and vanity in the use of this broader class of systems.

2.2 Appearance, & Self-Presentation in CMC

According to Goffman [16], an individual's attempt to "control" the conduct of others is exhibited by expressing him/herself in such a way as to give an impression that will lead others to act in accordance with her own plans. This managed expression of self is made by projecting different personas in our social interactions depending on the current audience, as well as the broader context.

Self-presentation and managing impressions in CMC have recently been examined by [11, 21, 27, 32]. Kimmerle and Cress [21] affirm that virtually all people feel the need to represent themselves in a particular way based on context. In line with this idea, Gangestad and Synder [14] coined the term "self-monitoring" to express the concept of self-observation and self-control guided by situational cues to reach social adequacy. Wolfe, Lennox and Cutler [34] proposed a distinction between Acquisitive self-presentation and Protective self-presentation. Acquisitive self-presentation refers to the tendency of the self-presenter to realize social benefits or rewards when behaving appropriately in a certain situation. This reward is understood by Goffman [16] as the expected conduct of others. Protective self-presentation refers to the avoidance of social rejection, and behaving appropriately in social situations.

Other previous research has suggested that users are concerned about their appearance, but provide very little empirical data to support these claims. For example, Noll [1992] states that "many people were uncomfortable being 'on camera'" and that while some people "might like to see the other person while talking on the telephone, very few are willing to be seen". More recent work by Campbell [8] relates users' apprehension to participate in videoconferences to the level of self-consciousness about on-screen appearance and performance and comments that "this self-consciousness is often very noticeable and can be a significant impediment to effective communication."

One concern when providing users with a feedback video during a videoconference is the potential increase in cognitive load. Hinds [19] work suggests that audio-video systems that allow for multiple images (the partner's video, the user's video, and other data screens) can increase cognitive load. In addition, Storck and Sproull [29] suggest that when the feedback video is displayed on the local screen, it increases salience of the self. As a result, users with high communication anxiety may tend to look at themselves

more, which can have a negative impact on their partner's impression of them.

2.3 Information Filtering Techniques in CMC

Many studies have been carried out examining image filtering techniques as privacy support tools. Neustaedter, Greenberg, and Boyle [24] analyzed the effect of blur filtration over privacy in home based conferencing. In this work they classified three groups of image filters: distortion, subtraction, and eigen-space filters. Distortion filters are used to obfuscate the image using techniques such as blur and pixelize. A blur filter usually refers to a process that averages neighboring pixels to produce a blurry image [36]. A pixelization filter divides an image into a grid of x-pixel wide by y-pixel high blocks. Then, within each block the filter calculates the average intensity and color values, and assigns them to all the pixels in that block. A subtraction filters removes aspects of an image, such as the static background of a scene. Finally, eigen-space filters [9] remove socially inappropriate aspects from an image and reconstructs it using pre-defined information.

Boyle, Edwards, and Greenberg [6] analyzed the impact of blur and pixelizing techniques over awareness and privacy in media space systems. Their results suggest that both filtering techniques have a level suitable for providing awareness while maintaining privacy (i.e., blur filter around level 5 and pixelize filter around level 6). Zhang, Rui, and He [35] explored the idea of blurring the background in video conferencing instead of replacing the background completely. The proposed background blurring algorithm was tested for accuracy under a wide range of conditions (e.g., moving vs. still foreground objects, lighting changes, frontal vs. non-frontal faces, single vs. multiple persons) with good results differentiating the faces of the users from the background. However, user feedback on the resulting images was not obtained. In [19, 36], a different kind of subtraction filter, the shadow-view technique, was proposed to provide privacy in awareness support systems. In the shadow view technique the person is subtracted out of the image while the background is preserved; however, an investigation of various image manipulation techniques in a media space showed that the shadow view technique was seldom used [36].

Another information filtering technique, quite different from those already presented, is the use of surrogates or avatars. Surrogates are graphical personifications of an individual that can replace their image or video. Surrogates can be physical [17] or virtual, static [29, 31] or animated, and can be used to show users' facial movements or actions [22]. Surrogates can be used as a tool to support privacy in media spaces or video conferencing given that the users' "real" image is replaced and only the user's actions or gestures are communicated through the surrogate [17].

What is striking about all of the research around filtering techniques in image sharing communication is that the main objective of the research has been to support privacy or to find middle ground between privacy and awareness levels. The goal has primarily been to restrict information in order to preserve identity or hide information. The work in this paper instead examines filters from the perspective of enhancing or improving a user's image in order to increase their comfort when sharing the image.

We next describe two user studies we conducted to better understand whether personal, perceived image issues impact how

comfortable users are with media spaces and videoconferencing systems and how we might be able to improve users' comfort with their own image when using these systems.

3. STUDY 1: IMAGE CONCERNS IN VIDEOCONFERENCING

The goal of our first study was to explore the importance of the feedback window in a videoconference and to examine how comfortable users were with their self-image and whether or not they were concerned about their appearance in videoconferencing sessions.

Throughout the paper, participants are referred to by their gender and their id in the study (e.g. F1 = Female, Participant 1).

3.1 Participants

Twenty four participants (12 women) were recruited in three different gender groupings (F/F, M/M, F/M). All participants were employees of a large software company located in Northwestern United States. The participants ranged in age from 16 to 48 with a median age of 28 ($\mu=29.3$). When asked about their experience with videoconferencing systems, 79% of the participants (19) rarely or never used videoconferencing, 3 used videoconferencing monthly (F1, M5, M24) and 2 used videoconferencing weekly (F22, M3). None of the participants used videoconferencing daily.

3.2 Independent Variables

Two videoconferencing conditions were examined in this study: feedback video and no feedback video (see Figure 1). A feedback video is a window that shows the video currently being captured by the participant's own web camera and shared with their partner (i.e., their own video). This is sometimes referred to as a "mirror function" [23] or "confidence monitor".

The tasks used in this study were two, 5 minute brainstorming exercises. In the first brainstorming task participants were asked to plan a social event. In the second brainstorming task participants were asked to plan a training course.

Gender and gender pairing were also independent variables in this study.

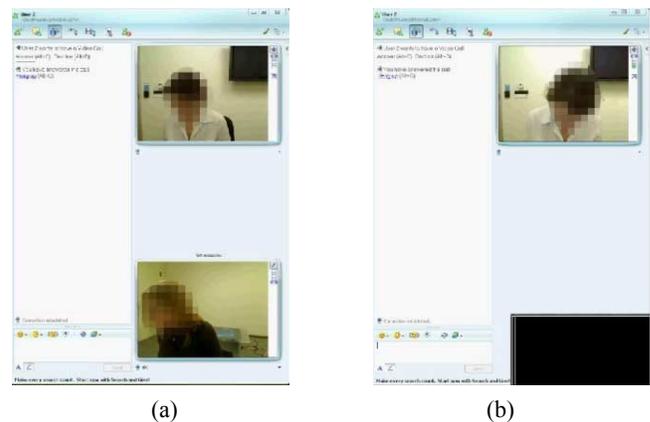


Figure 1: The two conditions examined in Study 1: (a) feedback video; (b) no feedback video. Normal video was used during the study, however, the faces are blurred in this figure to preserve the participants' identities.

3.3 Procedure

A within subject design was used with each pair of participants completing a task for each condition. The conditions were counterbalanced where half of the participants started with the feedback video present, and the other half started in the condition without the feedback video. Task order was also counterbalanced.

Each partner was placed in a separate room with a computer configured for the videoconferencing session. Windows Live Messenger was used to host the videoconferencing session and each computer was equipped with a web camera and speakerphone. Additional video cameras placed in each room were used to capture the participants and their screen during the session. A Tobii x50 eye-tracker was used to record eye fixation points for one participant in each pair. The computers were Intel core 2 duo processor 3.00GHz, 4.00 GB RAM, desktops with a 1280x1024 resolution display and standard keyboard and mouse.

After each task, participants were asked to report on their comfort level with the videoconference experience. At the end of the session participants were asked to complete a post-session questionnaire which inquired about their experience with the different conditions.

4. STUDY 1 RESULTS

4.1 Desire for the Feedback Video

Boyle and Greenberg [7] discuss the use (and need) of feedback channels in media spaces to support self appropriation and avoid inadvertent privacy violations. This need was validated in our study with 71% (17) of the participants stating that they felt the feedback video was important. Not surprisingly, the most common reason participants wanted to see their feedback video was because they desired to know what the other person's view of them was (19/24). For example, F1 stated that she "like[d] to know what the other person is seeing" and M16 commented that he wanted to "see how [he was] presenting [himself] to the other person". The remaining 29% (M3, F8, F12, M15, F17, M19, M20) felt that the feedback video was not important, and four of these participants (F8, F12, M19, M20) preferred the condition without the feedback video.

4.2 Comfort with the Feedback Video

Because of issues such as camera angle and lighting, checking the feedback video is beneficial to verify that the image being shared is appropriate; however, appearance was also a concern for the participants in our study. Twelve participants indicated that they wanted to see their own video to make sure that they looked ok (F1, F2, M5, F6, F8, M9, M10, F11, F13, M14, F17, F23). Their freeform comments also support this conclusion:

- "I wish to see how I look like in the video sometimes in case I have some mistake, like a horrible hair-style" (F6);
- "It is good to know at first if your hair/face looks weird or good" (F8)
- "It is important that you see what the other person is seeing because you make sure [you are] not doing anything weird." (F13)
- "It is nice to know what I look like while I'm talking" (M14)

Several participants also expressed that it was distracting to have the feedback video visible and that it made them self-conscious about their image.

- "I tried not to look at myself because it was distracting to see how I looked" (F2)
- "I don't like to see myself, it's not useful and can be distracting" (F12)
- "Seeing my own image was a little distracting" (M19)
- "Seeing myself was distractive at times, kept worrying about how I was coming across" (M20).

Analyses of the videos also indicated that the users were aware of their self-image in the feedback video, and some were self-conscious about their appearance. For example, in the feedback video condition, all of the women and half of the men looked at their feedback window and made some attempt to modify their appearance (e.g., fixed their hair, adjusted their eye glasses, shifted their posture).

4.3 Attending to the Feedback Window

To assess whether or not the feedback video was a distraction, we examined eye-tracking data from eight¹ participants to see how often they looked at their feedback video. For the eight participants who we collected eye-tracking data from, Table 1 indicates the number of glances each participant made to their own video. All participants glanced at their feedback video at least a few times while some glanced at the feedback window many times. For example, one woman glanced at her own video 133 times. Although this data suggests a gender difference, further research is needed to validate this result since our statistical power was low.

Table 1. Number of times users glances at the feedback video.

# of Glances at the Feedback video			
Female		Male	
ID	#	ID	#
F1	133	M14	30
F8	21	M16	4
F17	14	M24	4
F21	23	M20	3

We also analyzed the eye-tracking data to determine when during the session participants glanced at the feedback video and found that 55% of the glances occurred during the first minute of a task (see Figure 2). Although the number of glances seems to taper off as the task progresses, we see an increase in the number of glances near the end of the task.

¹Eye-tracking data were collected from 12 participants, however, there were times when the equipment was unable to determine eye-fixations (because the camera was blocked or the participant moved out of the frame). As a result, we only have full eye-tracking data for 8 participants.

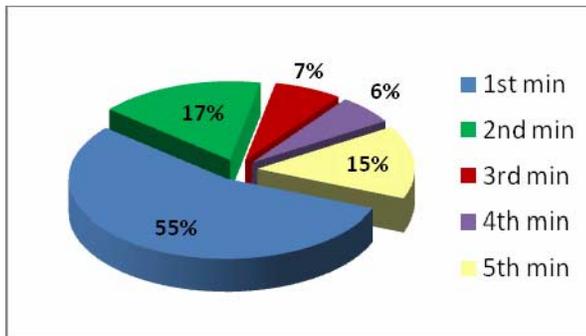


Figure 2: Percentage of glances users made to feedback video per minute of task.

Participants were also asked to report when they preferred to look at the feedback video, and 42% (10) indicated occasionally, 38% (9) always, 17% (4) at the beginning of session and one participant never wanted to have the feedback video visible (M19). Some comments when justifying these answers included:

- “It is good to know at first if your hair/face looks weird or good, but after that I don’t want to see myself” (F8)
- “I’d like to be able to glance at it any time” (M7)
- “I like to see myself at the beginning” (F2)
- “I think it helps only during the set up period” (M3)
- “I like to look at myself” (F13)
- “I really didn’t like seeing myself” (M19)

Observation of the video data also revealed that participants tended to glance at their feedback video when they made physical expressions such as facial expressions, moving their head, brow, mouth or hands or simply changing their position.

5. STUDY 1: DISCUSSION

The results from Study 1 show that many users do want to view their feedback video during a videoconference, both to ensure that the image they are sending is appropriate (i.e., in the frame), and to maintain an awareness about their appearance. These results reinforce the idea that users want feedback in their image sharing communication systems to support self-appropriation [3, 7]; however, our results also clearly demonstrate that appearance and vanity are key concerns for users and are a main reason why users want to view their feedback image.

The results from Study 1 also show that users often want feedback about their appearance, particularly at the beginning of a session. However, some users are self-conscious about their image and find it distracting to see their own video. Videoconferencing systems need to make sure that they provide users with the option of viewing their feedback window, but should also enable users to control when this information is visible and what level of salience it has.

Before beginning this study we hypothesized that gender would be a significant factor; however, both men and women in our study made numerous comments regarding how they “looked” in the video. Further research is needed to determine whether or not the magnitude of concern is different for men versus women.

Our next study continues to explore image and appearance concerns, but focuses on media spaces. We also explore whether image manipulation techniques can help people be more comfortable with the images they share.

6. STUDY 2: IMAGE CONCERNS IN PRESENCE DISPLAYS

For our next research stage, we ran an in-situ study in the individual offices of 12 participants. The participants had their pictures automatically taken during random moments over a two-day period. After this, we asked them to respond to four questionnaires about the images (two about the pictures taken and two more about image filtering and sharing the images more broadly). Based on the questionnaire data, we analyzed questions related to image issues; namely, participants’ comfort when seeing and sharing their own pictures, information disclosed in the pictures, and which image filtering techniques might best support users’ comfort when sharing their images.

Again, participants are referred to by their gender and their id in the study (e.g., F27 = Female, Participant 27). Id numbers for Study 2 ranged from 25 to 36.

6.1 Participants

Twelve participants (6 female) took part in the second study. As in the first study, all participants were employees of the same large software company. The participants ranged in age from 25 to 48, with a median age of 28 ($\mu=30.9$). When asked about their experience with videoconferencing systems, 75% (9) of the participants either rarely or never used videoconferencing. The remaining three participants reported that they used videoconferencing systems monthly (F27, M33) or weekly (M26).

6.2 Image Filters

Eleven different image filters (see Figure 3) were explored in an attempt to improve participants’ comfort with their image. The filters were selected based on previous work related to media spaces, awareness, and privacy. These include: distortion techniques [6, 23, 35, 36], background subtraction/distortion techniques [19, 35] and use of surrogates [17, 29, 31]. In addition, we also wanted to explore filtering techniques that modified or enhanced users’ appearance [1]. The four different classes of filters were explored were:

6.2.1 Distortion filters

1. Blur
2. Darkening
3. Pixelizing
4. Flare the face

6.2.2 Background subtraction/distortion filters

5. Blur the background
6. Remove the background

6.2.3 Image/appearance artistic filters

7. Vectorize the edges
8. Show in pen & ink
9. Cartoon-ize (rotoscope technique)
10. Improve the face (bilateral filter)

6.2.4 Use of surrogates

11. Use an avatar to show facial movements

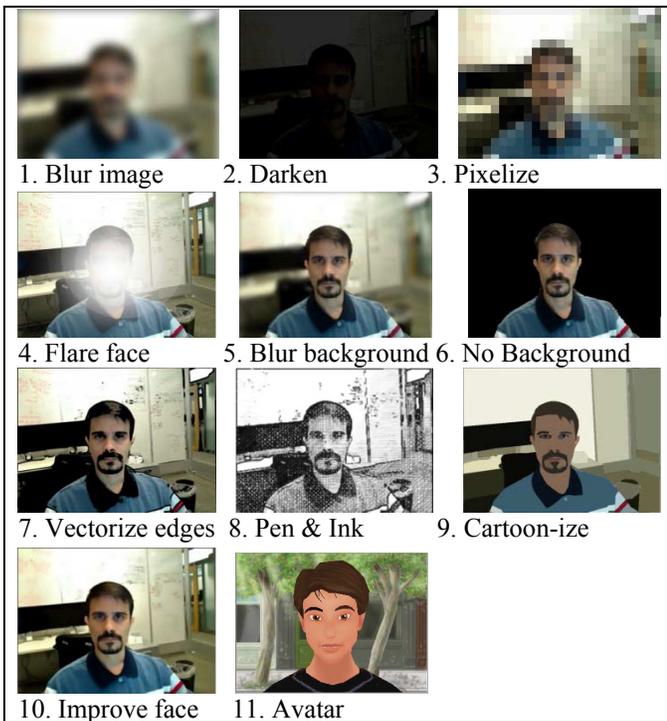


Figure 3: Image filters used in Study2, applied over participants' images

The levels of blurring and pixelizing for the filters were selected based on the results presented in previous work [6, 23]. A level 5 blurring (neighborhood of 52x35) was used and a level 7 (8x6 grid) for pixelizing.

6.3 Procedure

Participants first completed a background questionnaire which inquired about their experience with video conferencing systems and asked them how comfortable they were sharing images or videos to provide awareness information to different groups of people (e.g., boss, close colleagues, everyone). Next, a web camera was installed on top of each participant's work monitor along with a software application that took a picture at a random time throughout the day and emailed the picture to us. No warning was given before the picture was taken. We then emailed the participants a questionnaire with the randomly collected image, asking them how comfortable they were with the picture and what information shown in the picture bothered them the most. We also modified the picture using the eleven different filters and asked the participants to rate how comfortable they would be sharing the modified pictures with their close work colleagues. Two days later, another picture was automatically taken by the web camera, emailed to us, and another image questionnaire sent with the same questions. At the end of the study, participants completed a post-study questionnaire which asked them to select which image filtering technique they preferred for four different video-conferencing scenarios.

7. STUDY 2 RESULTS

7.1 Comfort with Media Spaces

All participants were asked what they thought about sharing an image or video taken automatically from a web camera to provide better awareness information to close work colleagues. Three of the participants (all male, M29, M31, M33) liked the idea of sharing images and video and felt it would be useful. Four participants (F30, F35, F36, M32) were comfortable sharing an image, but not video. The remaining five participants (F25, F27, F34, M26, M28) were not comfortable sharing either an image or video. When asked to comment on why they were comfortable or uncomfortable sharing images and video, several participants commented that they felt it invaded their privacy ("too much invasion of privacy", M29), and that it would make them "self-conscious" (F25). Those that were comfortable commented that it was something that they already do on various websites (M33), and that it would allow their colleagues to get an accurate representation of their personality (M28).

7.2 Image Concerns

In the questionnaires completed after seeing the random image of themselves, participants' level of comfort with the images ranged from extremely comfortable to extremely uncomfortable. When asked what information bothered them the most about their image, appearance was the most frequently stated concern (12 users). Other information that bothered our participants was the context of the picture (e.g., a messy desk) (2), their office mate's screen (1), and the presence of another person in their office (1). The freeform comments also strongly suggested that appearance was a significant factor in whether our participants were comfortable or uncomfortable with their image. For example, participants commented:

- "my hair looks bad" (F27)
- "it is not a flattering picture" (M31)
- "I bite my nails when I'm stuck with a thought—something I'd like to show my colleagues who don't know me well." (F36)
- "not my best angle" (M29)
- "facial expression makes me a little uncomfortable" (M32)
- "I don't like the face I am making" (F35)
- "I look funny" (F27)
- "I look exhausted" (M28)
- "It seems like I am picking my nose" (F30)
- "I don't really like the picture" (F35)
- "my face looks serious and angry" (M26)

Participants tended to be comfortable with their image when it was an accurate representation of them: "it is a normal image", "a natural state", "looks like me". Positive actions or gestures (or the lack of negative actions) also made people comfortable with their image:

- "I am not scratching my head or making a grimace or something" (F25)
- "I look like I'm thinking hard and working hard" (F27)
- "shows me concentrating on something" (M32)
- "I'm not picking my nose" (M29)

Although participants were concerned about their own appearance, when participants were asked what information they

would like to know about their colleagues, appearance was the lowest rated attribute (only 1 participant indicated that he was interested in this information). Instead, participants primarily wanted to know their colleagues availability (12) and presence in the office (10).

7.3 Image Filters

Participants were asked whether they felt it would be useful if the system offered the possibility to change the appearance of their image. Ten of the twelve participants felt that this would be “somewhat useful” while two participants felt that it would not be useful (M26, F36).

Comparing the filter ratings for all participants, for both pictures, we found a significant effect of filter ($F_{10,100}=2.66, p=.006$), but no significant effect for gender ($F_{1,10}=2.10, p=.178$) or whether it was the first or second picture ($F_{1,10}=2.92, p=.118$). The average ratings for each image filtering technique are shown in Table 2, and the average ratings for the different types of filters are shown in Table 3. The filter which cartoon-ized the participants’ image was rated highest amongst the filtering techniques explored while darkening or pixelizing the image or flaring the face were the lowest rated filtering techniques.

Table 2: Average user ratings for each image filtering technique.

Filter #	Description	Mean	S.E.
9	cartoon-ize	5.58	.77
11	avatar	4.92	.87
10	blur background	4.83	.57
8	pen and ink	4.67	.51
1	improve face colors	4.42	.62
2	blur image	4.04	.62
7	remove background	3.79	.60
4	vectorize edges	3.17	.62
5	darken image	2.96	.60
6	pixelize image	2.96	.67
3	flare face	2.67	.78

Table 3: Average user ratings for each class of image filtering techniques.

Filter Classes	Mean	S.E.	95% Conf. Interval	
			Lower Bound	Upper Bound
Use of surrogates	4.917	0.866	2.988	6.845
Appearance filters	4.458	0.468	3.415	5.501
Background filters	4.313	0.526	3.139	5.486
Distortion filters	3.156	0.611	1.795	4.517

In the post-study questionnaire, participants were presented with four different videoconferencing scenarios and asked to indicate which filter (if any) they would feel most comfortable using in

that context (see Table 4). In all four scenarios, all but one or two participants wanted to apply a filter to their video.

Table 4. Preferred filters for four different videoconferencing scenarios (S1, S2, S3, and S4)

Type of Filter		S1	S2	S3	S4
None		1	2	1	2
Surrogate	Avatar	4	2	2	1
Appearance	Cartoon	3	3	3	
	Pen/Ink	2	2		1
	Soft Colors	1	2		
Background	Remove Background			1	6
	Blur Background			5	2
Distortion	Blur Image	1	1		

In the first scenario, the participant is late for work and does not have time to comb their hair, wash their face, or dress nicely before a conference call. In the second scenario, the participant has had a long stressful day and is tired and in a bad mood. In the third scenario, the participant has papers everywhere on their desk, including private things. In the fourth scenario, the participant needed to bring her son to the office.

These four scenarios represent somewhat extreme situations where the person does not look their best, or potentially has non-relevant information on their desk or in their office. The use of the appearance filters or the surrogate were the most commonly selected techniques, with cartoon-ize being the most popular appearance filter. Background manipulation techniques were the next most popular choices. Distortion techniques were rarely selected, and the following four filters were never chosen: flaring the face; vectorizing the edges; darkening the image; and pixelizing the image. Three of these techniques severely distort the image, making it difficult to see any context. This result matches the ratings from the image questionnaires.

8. STUDY 2: DISCUSSION

Although none of the image filter techniques were significantly preferred over others, several interesting trends were observed. The users in our study did not like the techniques that heavily distorted their image. This result can likely be explained in light of the results from Study 1 which indicates that users are concerned over their appearance in image sharing systems. Instead users preferred techniques that they felt “enhanced” or “improved” their image, or merely ones that they felt were a good representation of themselves.

Although the results from Study 2 indicate potential for image enhancement filters, there are a number of issues with Study 2 which limit the generalizability of the results. First, still images were used instead of video. We chose to use still images because it enabled users to quickly compare a large number of different filters. Additionally, it allowed us to explore techniques that do not currently run in real-time. Further research is needed to gather users’ impressions of these techniques for video.

Study 2 was also designed to explore how comfortable users would be with their appearance in a media space. We chose not to give users any warning that their picture was being taken although they were told that the images would only be shared with close colleagues. This is analogous to an always-on, or on-demand media space within a work team. Our results may differ if users were given advance warning that the picture was being taken.

9. CONCLUDING REMARKS

The research presented in this paper provides initial insights on users' comfort level with respect to appearance and vanity concerns in videoconferencing and media spaces. The results of this work clearly demonstrate that users are concerned about their appearance and that for many, it can be a source of discomfort or distraction when they are participating in a videoconference or media space. Study 1 showed that most users want to be able to see the image they are sharing (e.g., feedback video), often because they want to see what they look like in the image. Study 1 also showed that users do look at the feedback video in videoconferencing sessions, often at the beginning of a session to check (and potentially correct) their appearance. Some users continue to glance at their video image throughout a videoconference while others find it distracting and prefer not to continuously monitor their video.

Study 2 showed that a randomly taken picture of a user can project negatively perceived personal imagery that can make a user uncomfortable with their appearance in a media space. The good news is that Study 2 also provided us with preliminary evidence that filtering techniques can help lessen these concerns. One important result from this work is the realization that commonly discussed filtering techniques in the literature today were not preferred by our users, as they tend to distort the users' images too much. Instead, users seem to prefer filters that subtly enhance their image, such as cartoon-izing [1] or background reduction techniques. Alternatively users may be interested in an avatar based approach.

Given the importance of a user's perceived image during social interaction, we feel this research is an important first step and that these results are important for designers of videoconferencing systems. If users are not comfortable with their image, they may not embrace computer mediated tools and techniques. For future work, we feel it is important to analyze the intercessions and differences between privacy and image related concepts. In addition, we need to explore the influence of other variables such as age, gender, or culture, concerning image issues in the use of media spaces and videoconference systems. Finally, we plan to examine users' image filter preferences when applied to live videos (in real time) in media spaces and videoconference systems.

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