Photowork Research

Auk Kim
kimauk@gmail.com
https://www.kimauk.com/

Paper

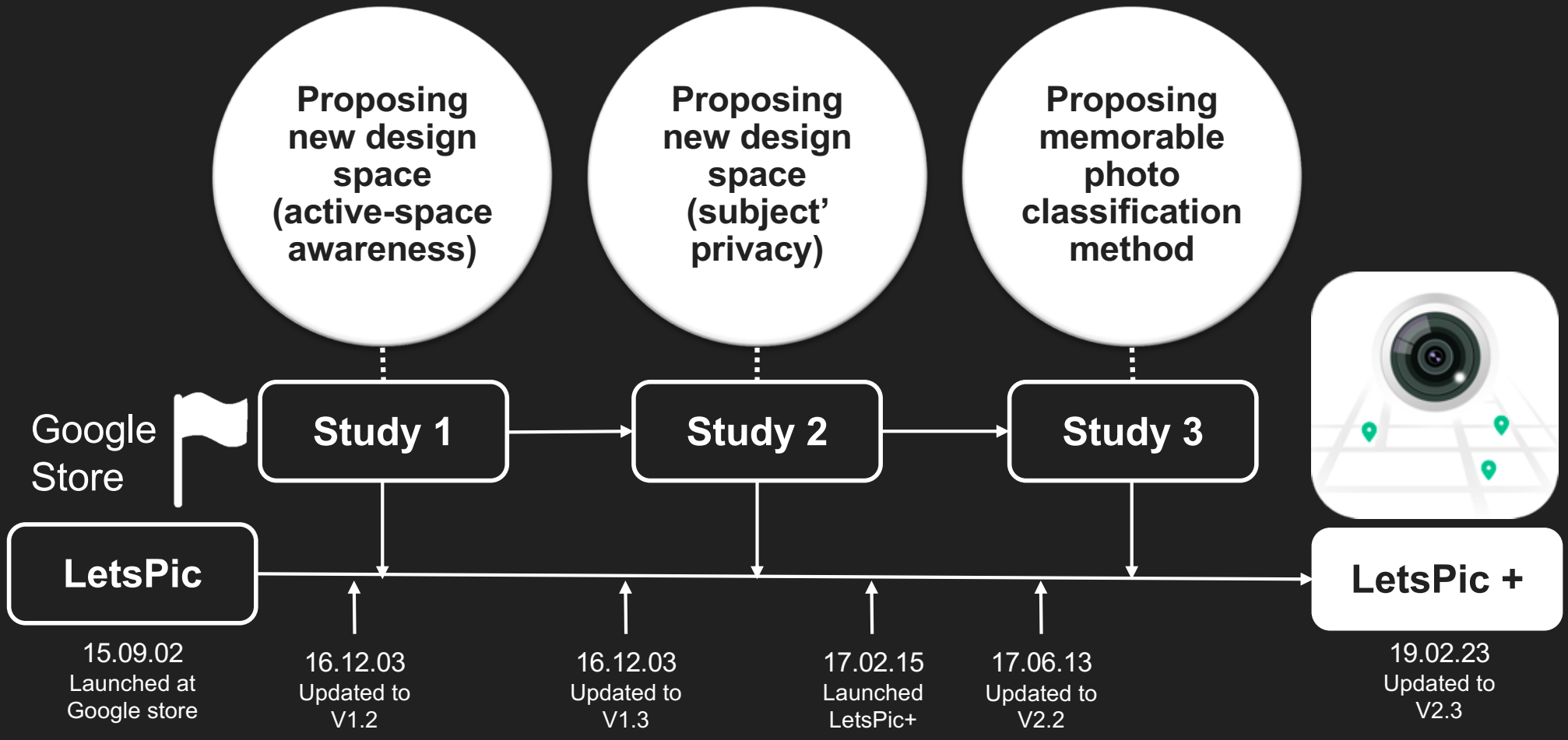
- Kim A, Kang S, Lee U. "LetsPic: Supporting In-situ Collaborative Photography over a Large Physical Space." In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '17). ACM (2017). * Top HCI conference
- Kim A, and Gweon G. "Photo sharing of the subject, by the owner, for the viewer: examining the subject's preference." In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '14). ACM (2014). *Top HCI conference
- Kim A, and Gweon G. "Comfortable with friends sharing your picture on Facebook?-Effects of closeness and ownership on picture sharing preference." *Computers in Human Behavior* 62, 666-675 (2016). *SSCI

Poster

- Kim S, Patra K, Kim A, Lee G, Segev A, Lee A. "Sensors Know Which Photos Are Memorable." In *Proceedings of the 2017 CHI Conference Extended Abstracts on Human Factors in Computing Systems* (CHI '17 Works-in-Progress). ACM (2017). ***I was a research mentor**

Research Overview: LetsPic – Group Photoware

- LetsPic was iteratively developed (e.g., (1) prototyping and (2) testing by launching at Google Store)
- LetsPic covers full cycle of activity (or work) related to photography (e.g., capturing, seeing and sharing)



After 3 year research, LetsPic was removed from Google Store, you can still download final version at following app archive site:
https://apkpure.com/letspic-레츠픽-그룹여행-d2d사진공유/com.cloudlet.letspic

Media Coverage

Newscast

- YTN 뉴스홈. "*[대전·대덕] 카이스트, 데이터 소비 없는 사진 공유 기술 '렛츠픽 ' 개발*" (16.01.15). https://www.ytn.co.kr/_ln/0115_201601151727166046
- *YTN Science. "데이터 소비 없이 실시간으로 사진 공유한다" (16.01.14).* *https://m.science.ytn.co.kr/view.php?key=20160114105850423 2&s_mcd=0082&s_hcd=*

News paper

- 헤럴드경데. "*데이터 소비 없이 실시간으로 사진 공유…KAIST, 안드로이드 기능인 Wi-Fi 다이렉트 기술에 최적화된 렛츠픽 개발*" (16.01.13). http://news.heraldcorp.com/view.php?ud=20160113000669
- 한국경제. "*데이터 쓰지 않고도 실시간 사진 공유*" (16.01.13). https://www.hankyung.com/it/article/2016011370241
- 동아일보. "*KAIST 팀 '데이터 사용 부담없이 폰카사진 실시간 공유'*" (16.01.14.) http://www.donga.com/news/article/all/20160114/75890521/1
- 전파신문. "KAIST-리코시스, 와이파이 없이 실시간 사진공유 기술 개발" (16.01.13). http://m.etnews.com/20160113000328?obj=Tzo4OiJzdGRDbGFzcyI6Mjp7czo3OiJyZWZlcmVyIjtOO3M6NzoiZm9yd2FyZCI7czoxMzoid2ViIHRvIG1vYmlsZSI7fQ%3D%3D

Study 1:
LetsPic - Photoware over a Large Physical Space

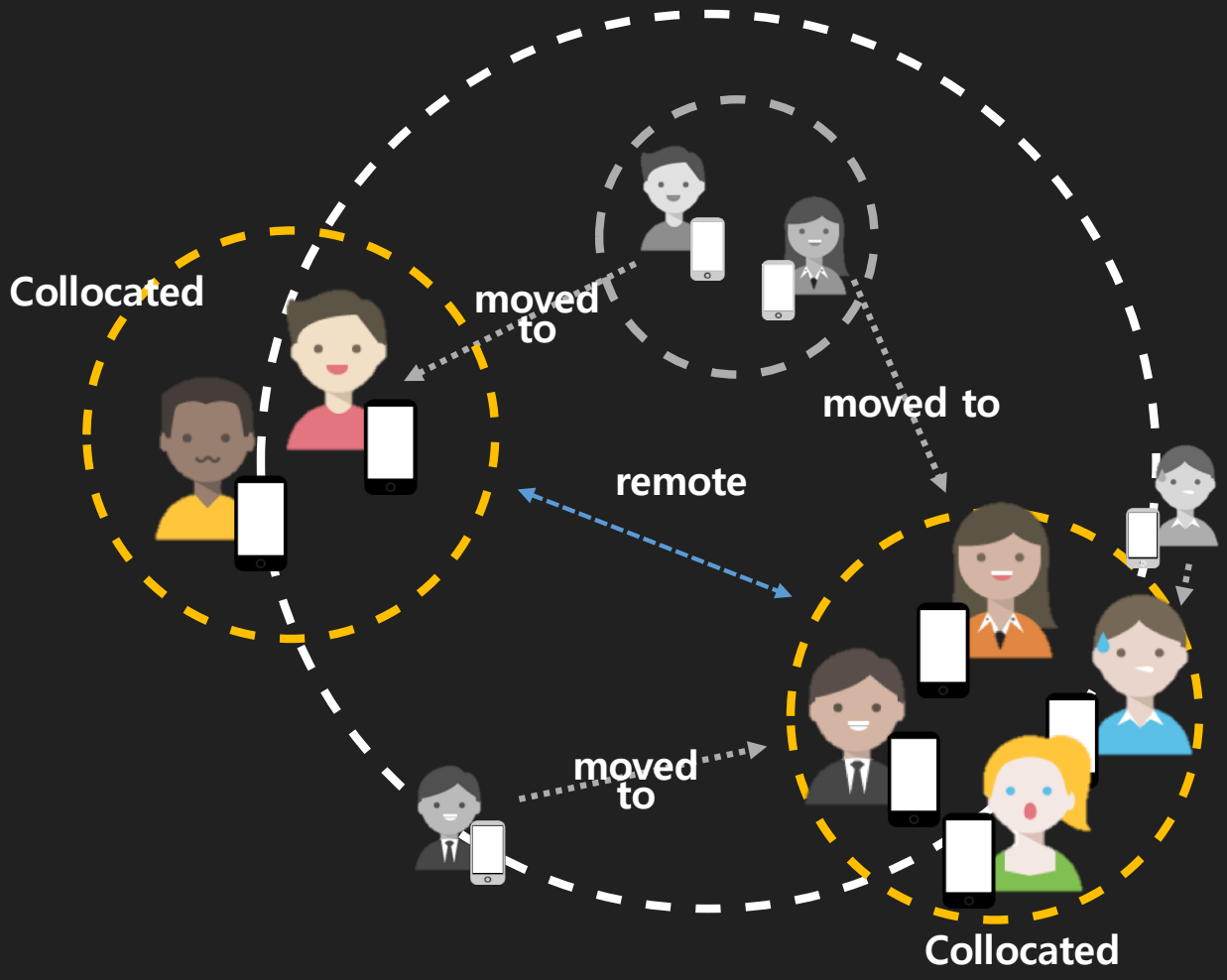
Kim A, Kang S, Lee U. "LetsPic: Supporting In-situ Collaborative Photography over a Large Physical Space." In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '17). ACM (2017). * Top HCI conference

A collocated environment is ideal for group activities

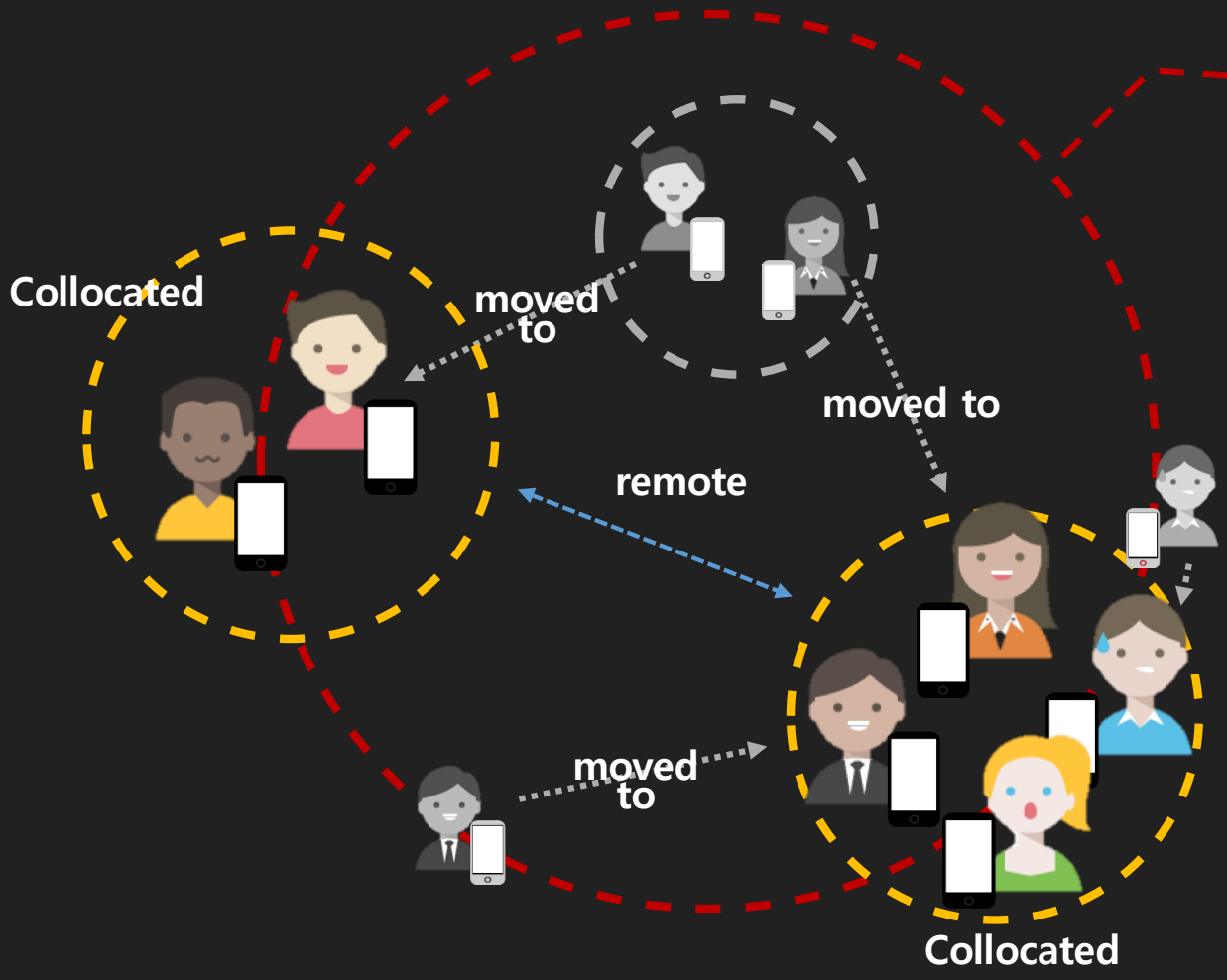
Prior studies mainly focus on group activities in which group members are in close proximity

But, recent advances in mobile computing technology have made it increasingly common for collocated groups to perform their activities over a large physical space

In a large physical space, group interactions may include a mixture of collocated and remote interactions, because of mobility and group dynamics, making maintenance of awareness for group activities over a large physical space very challenging



Definition of *'activity-space'* and *'activity-space awareness'*



We define:

- this environment as *'activity space'*
- *'Activity-space awareness'* as the up-to-data knowledge of group members; activity, location and interaction in an activity space

Unique design opportunities to support activity-space awareness for collaborative group over a large physical space

As a case study, we focus on collaborative photography

Collaborative photography is a type of photography that involve a group of people taking photos together typically for shared goals

Various application domains of collaborative photography

Collaborative photography in work context

- Collaborative site surveys (e.g., site reviews, construction sites, and natural habitat monitoring)
- Field trips (e.g., botanical gardens, zoos, and historical sites)
- Image-based research methodologies (e.g., geography, archaeology, and anthropology)

Collaborative photography in social context

- Group travel (e.g., theme park visits) and leisure/sports activities (e.g., outdoor festivals, marathons)
- Group photography tours and workshops (e.g., a visit by a camera club to scenic sites)

Main goal of out study

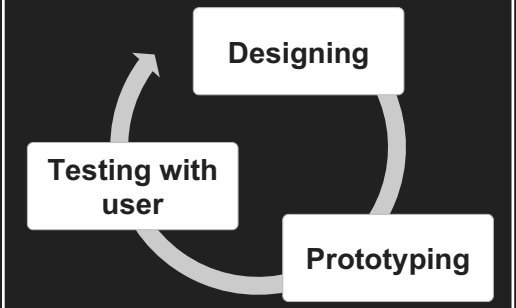
How to build a system capable of supporting in-situ collaborative photography in an activity space?

Procedure of our study

Formative study

- To understand group behavior, concerns, and problems in collative photography over activity space

Iterative designing and developing LetsPic



Case study with LetsPic in two difference types of usage scenarios

work context

VS.

social context

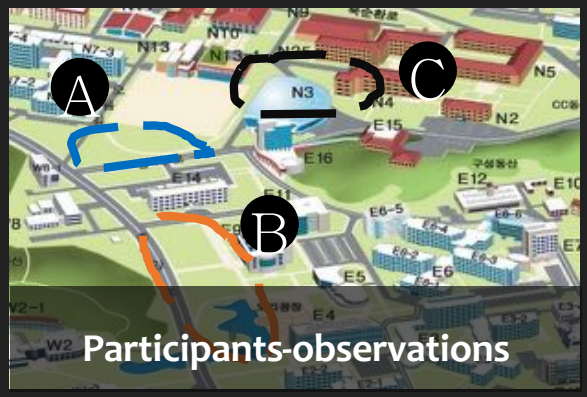
Formative study: Understanding of collaborative photography in activity space

Participants

- 17 people (4 groups of four to five members; 10 females and 7 males)

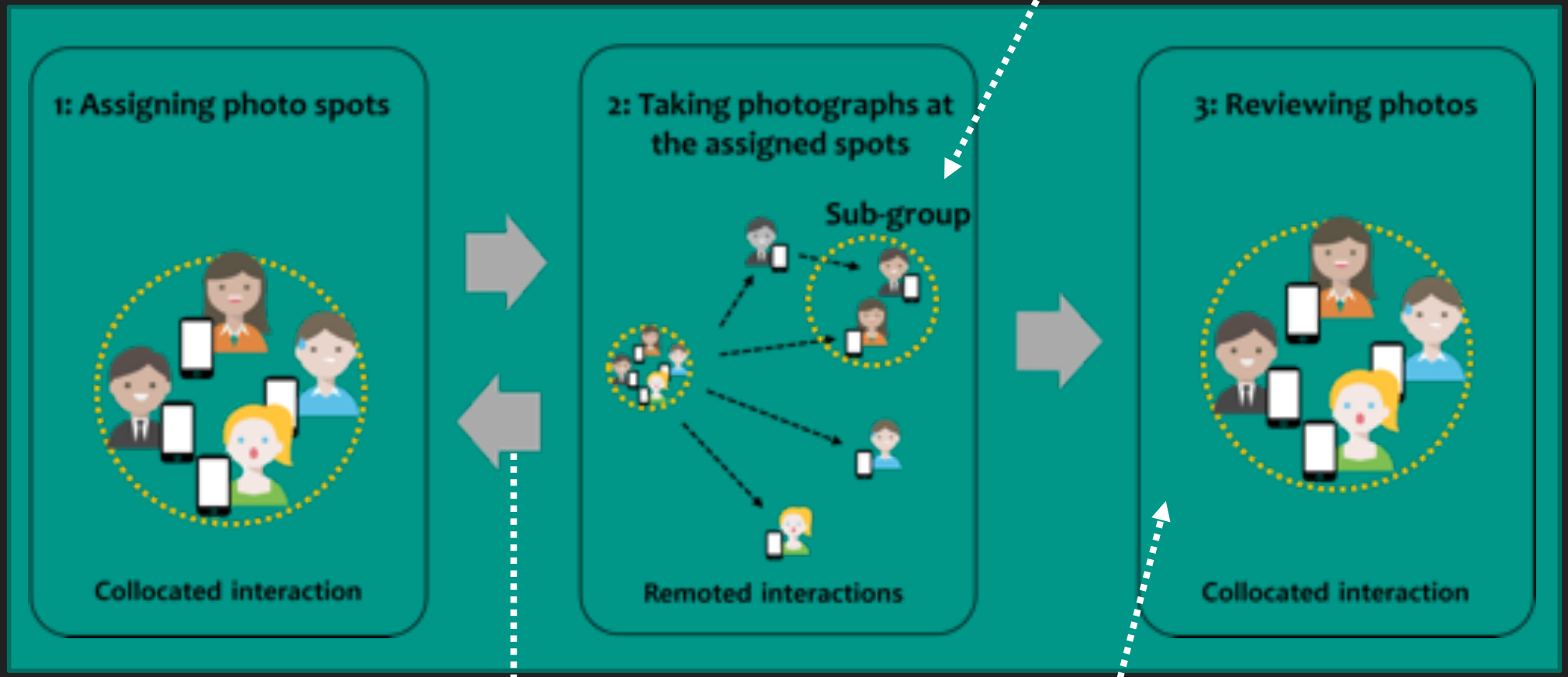
Procedure

- Site survey: collecting photos for introductory pages of three place in campus



Finding 1: Collaborative photography involving consists of multi sub-stages with different types of interactions (collocated vs. remoted interactions)

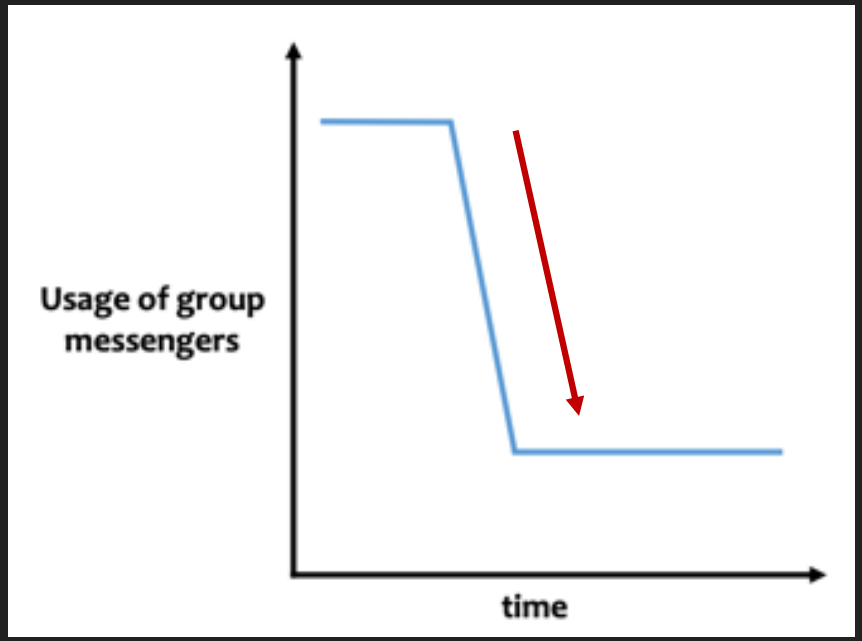
Owing to group dynamics, subgroups appear and subgroup-level collaboration happens opportunistic



Assigning photo spots within a sub-group

During the activity, group members are typically occupied with capturing photos, and photo reviewing only happens occasionally.

Finding 2: Messenger as photoware, but it's interruptive and frustrated



- Using group messenger for sharing photos, checking progress/ location, and discussing photos
- The messenger was only used rarely used subsequently because sending, receiving, and replying messages from/to other members were interruptive to their on-going activity, causing frustration to do so.

Finding 3: Evidences showing importance of activity-space awareness

Participants

- Often revisited the same place
- Captured redundant photos
- Being not aware of other members' behavior

As collaborative photography happens in an opportunistic fashion, providing activity-space awareness is very important.

Design requirements

As collaborative photography happens in an opportunistic fashion, providing activity-space awareness is very important.

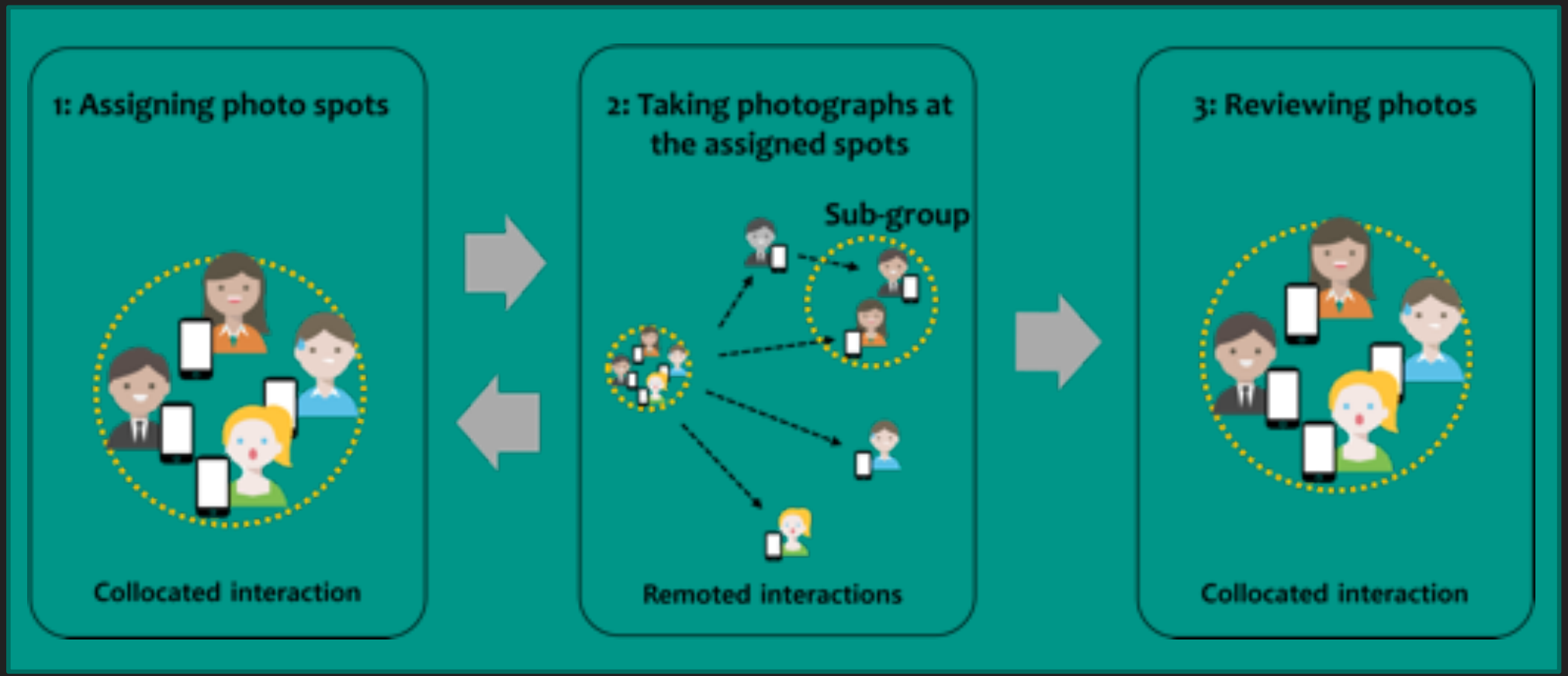
Requirement ①: Supporting two layered awareness

Requirement ②: Maximize awareness but minimize interruption

Requirement ③: Technical support for photo review

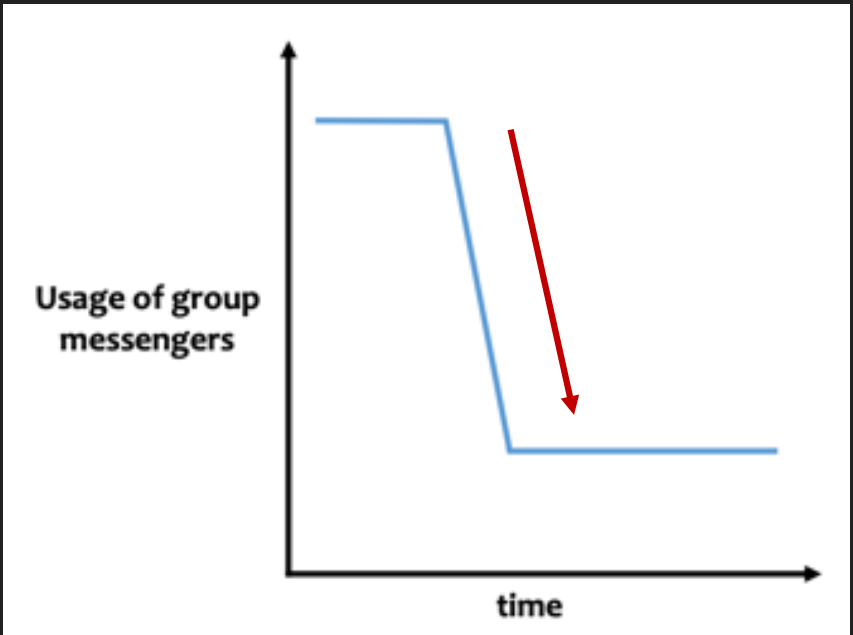
Design requirements: ① Supporting two layered awareness

Owing to group dynamics, subgroups appear and subgroup-level collaboration happens opportunistically, awareness should be supported in two layers: **an activity-space level for overall progress awareness** **vs.** **a localized level for subgroup activity awareness**.



Design requirements: ② Maximize awareness but minimize interruption

When enabling real-time awareness, it has to be carefully designed to minimize interruption



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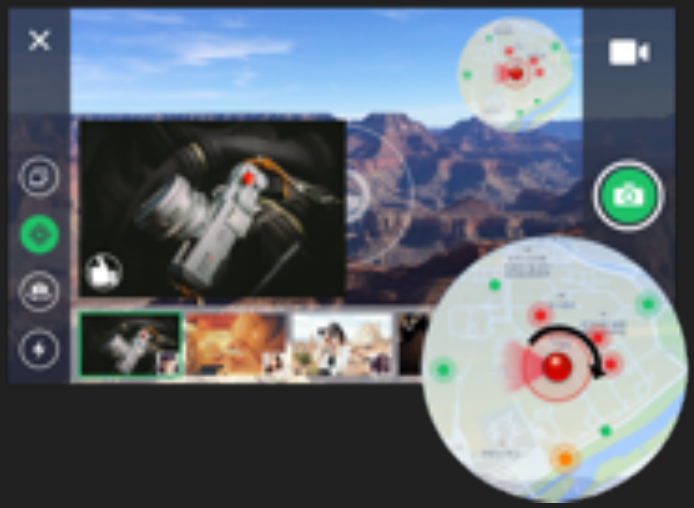
LetsPic: A photoware supporting activity-space awareness

The key design concept is to empower users with activity-space awareness to facilitate collaborative photography

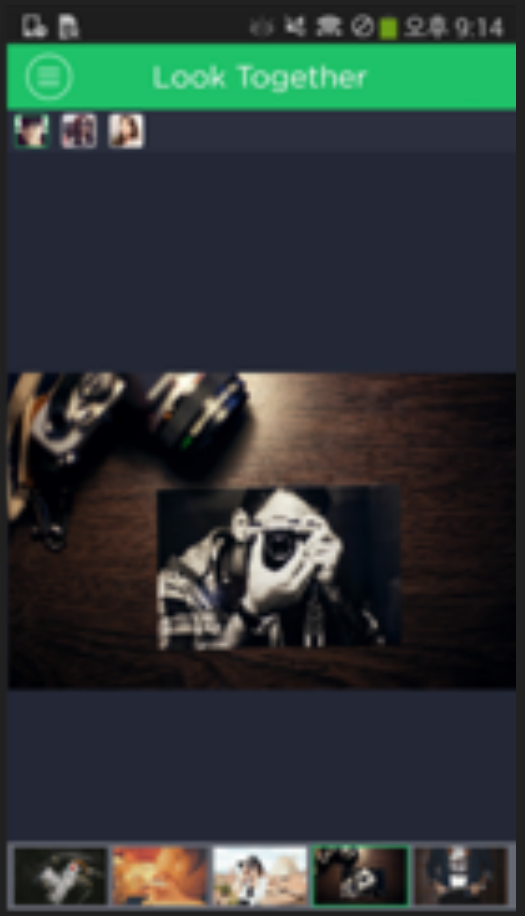
Galley mode

Camera mode: quick-gallery view

Camera mode: Radar view



Co-present mode

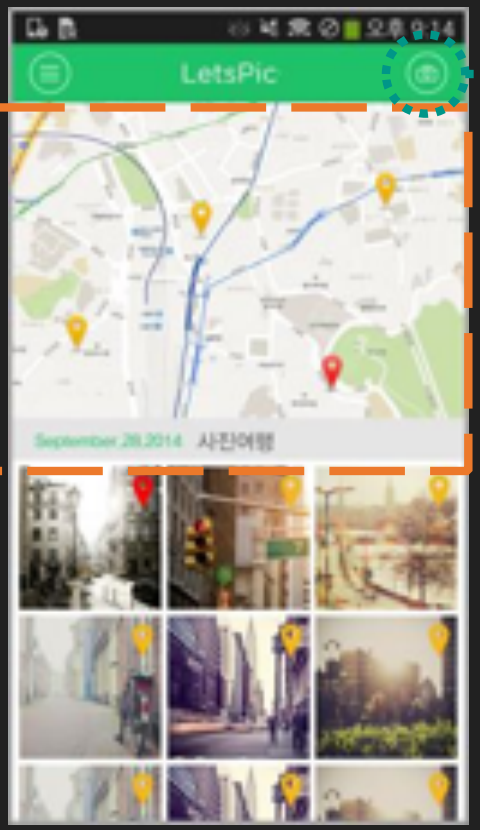


LetsPic: Gallery mode

Gallery mode provide detailed activity-space awareness (e.g., overall group progress)

Location of each photo as a colored marker to help users to maintain activity-space awareness

Galley Mode



Camera mode

Gallery mode was set as an initial landing page. To access to camera mode, users need to first visit galley mode.

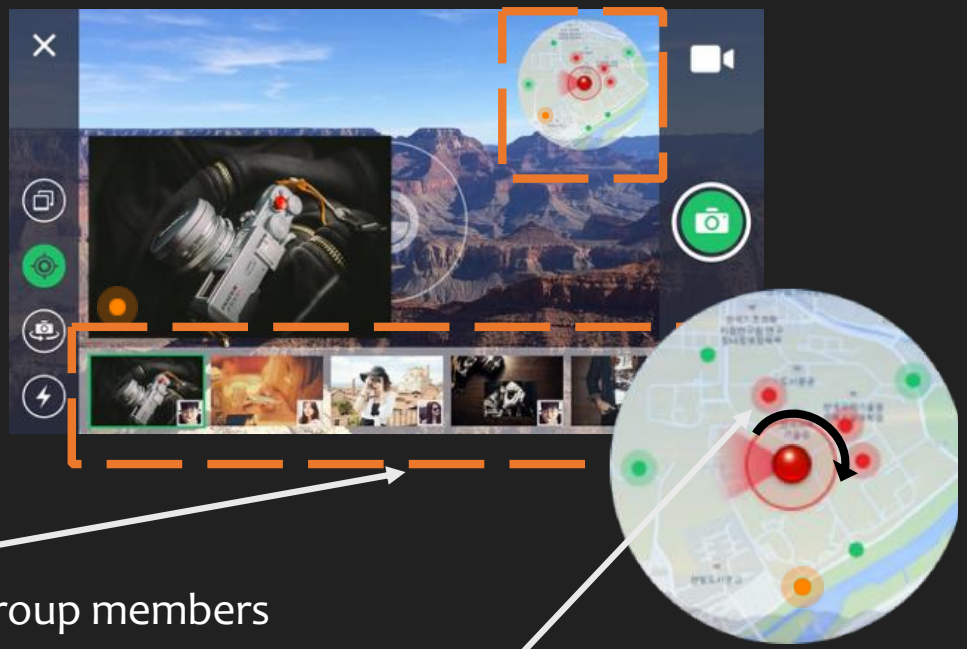
This design ensure users to always maintain up-to-date activity-space awareness (e.g., overall group progress)

LetsPic: Radar mode

Camera mode allows users to take photos while providing simplified activity-space awareness

Quick galley view

Radar view

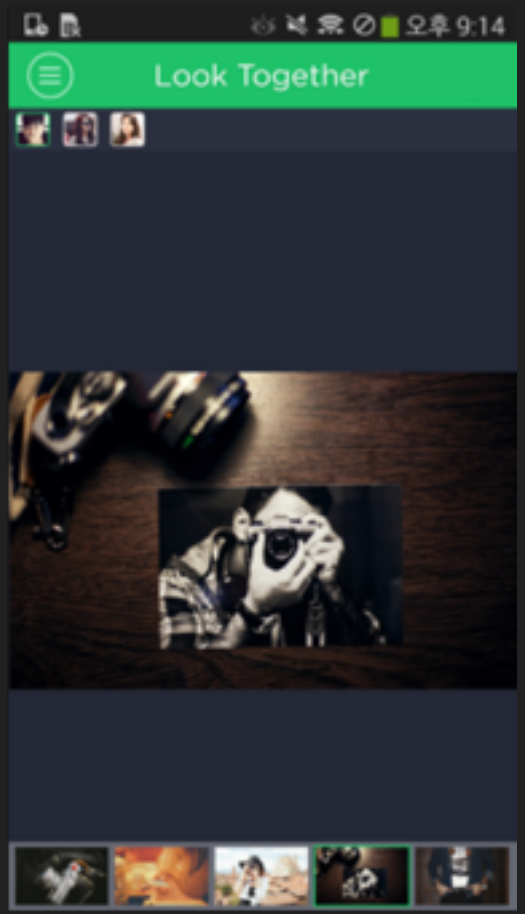


Displaying recent photos taken by group members

Displaying other members location

LetsPic: Co-present mode

Enabling collaborative photo reviewing with synchronized photo broadcasting, even when members are not within a close proximity



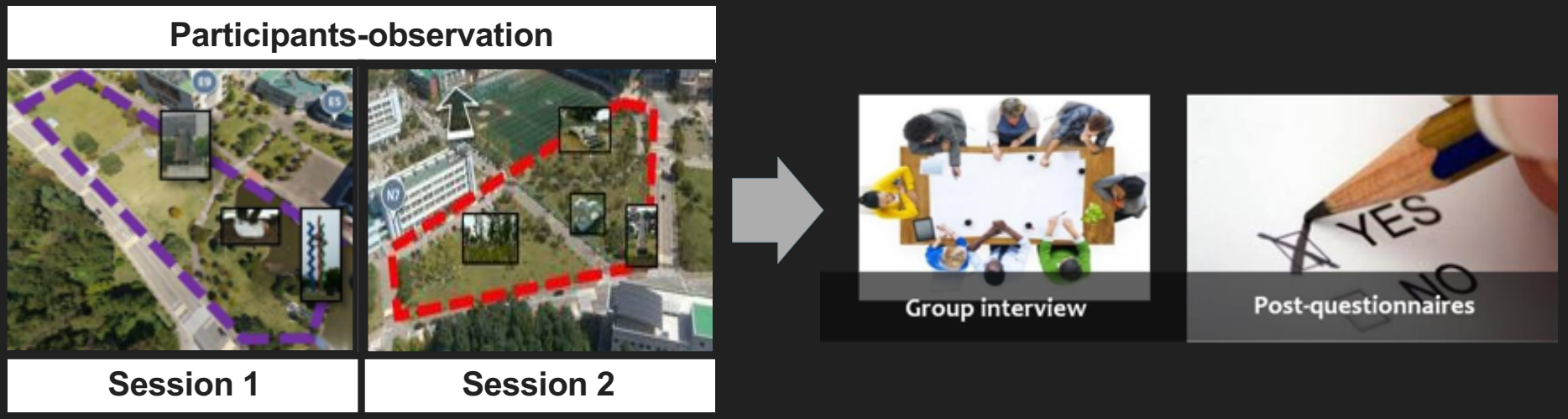
Case Study: Site survey - experience of LetsPic in work context (higher level of collaboration than case study 2, social context)

Participants:

- 31 people (12 groups of two to four members; 15 males and 9 females)

Procedure:

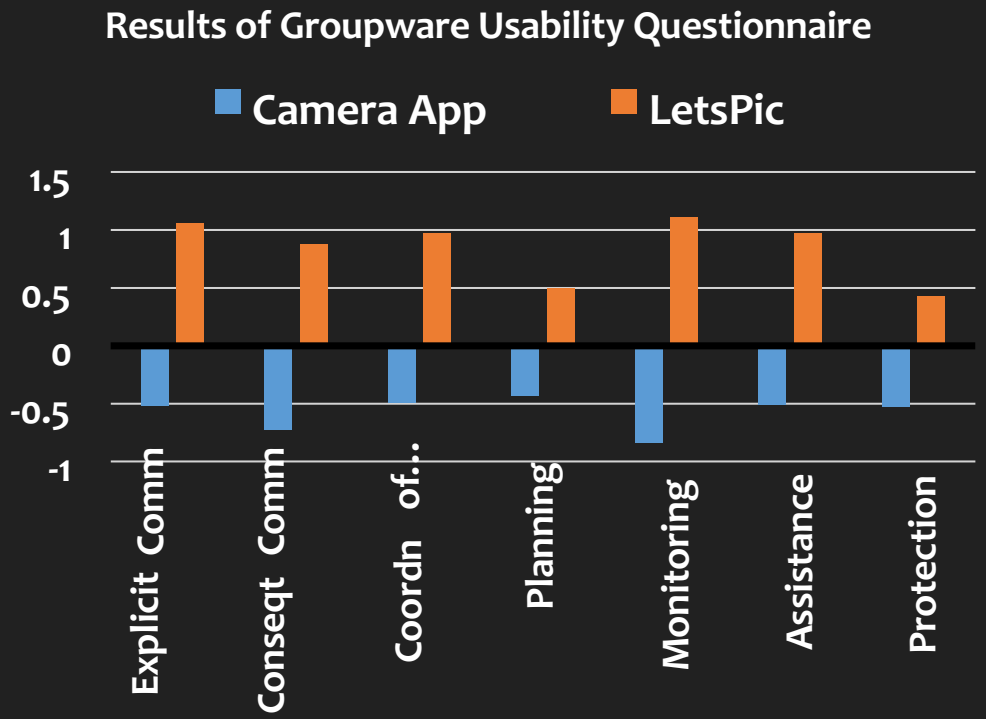
- Site survey: collecting photos for introductory pages of two places in campus



Results

LetsPic provided new opportunistic collaborative experiences

- An opportunity to capture unique photos by helping the participants navigate in the direction where members had not captured any photo yet.
- An opportunity to iteratively improve the quality of each photo in the groups' photo collections.
- An opportunity to improve the diversity in groups' photo collections.



E.g., PA4 said

"I used the gallery mode when I needed to check overall work progress [...] While taking photos, I used the radar view to check what others (collaborators) were doing if I needed to [...] To see recent activity of group members, I used the quick gallery view."

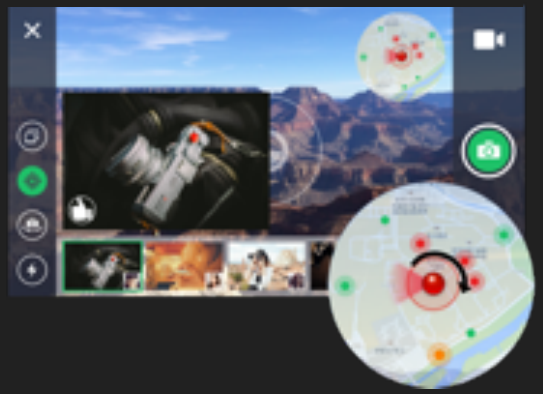
Conclusion

- Unlike to the traditional collocated environment, mobilecollocated interactions in a large physical space (activity space) includes a mixture of both collocated and remote interaction
- In activity space, mobility of group members and group dynamic make maintenance of awareness very challenging.
- Thus, awareness must be supported for group activities over a activity space.

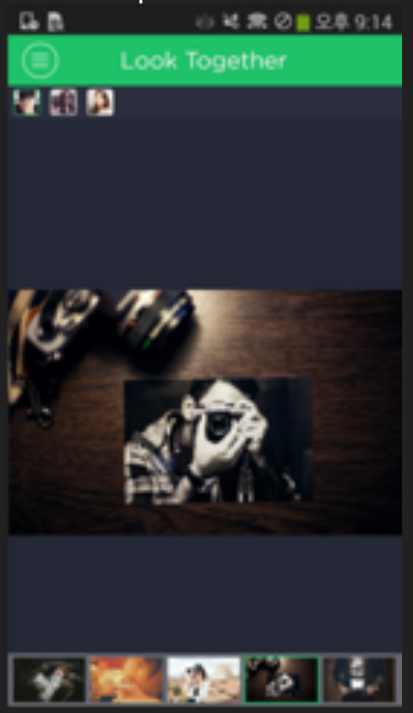
Galley mode

Camera mode: quick-gallery view

Camera mode: Radar view



Co-present mode



Study 2:
Examining and estimating the subject's photo sharing preference

- Kim A, and Gweon G. "Photo sharing of the subject, by the owner, for the viewer: examining the subject's preference." Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '14). ACM (2014).
- Kim A, and Gweon G. "Comfortable with friends sharing your picture on Facebook?-Effects of closeness and ownership on picture sharing preference." *Computers in Human Behavior* 62, 666-675 (2016).

Taking and sharing group photos help to create and maintain social relationships

- Altman 1973. Social Penetration: The Development of Interpersonal Relationships, Holt, Rinehart & Winston, Dalmas, 1973.
- Sleeper 2003 . The Post that Wasn't: Exploring Self-censorship on Facebook. In Proc. CHI 2013, ACM Press (2013), 793–802.

Taking and sharing group photos are becoming part of our daily lives

[Ebersman 2012]

- Ebersman. Facebook, Inc Registration Statement on Form S-1. Securities and Exchange Commission. 1, (2012).
- Sleeper 2003 . The Post that Wasn't: Exploring Self-censorship on Facebook. In Proc. CHI 2013, ACM Press (2013), 793–802.

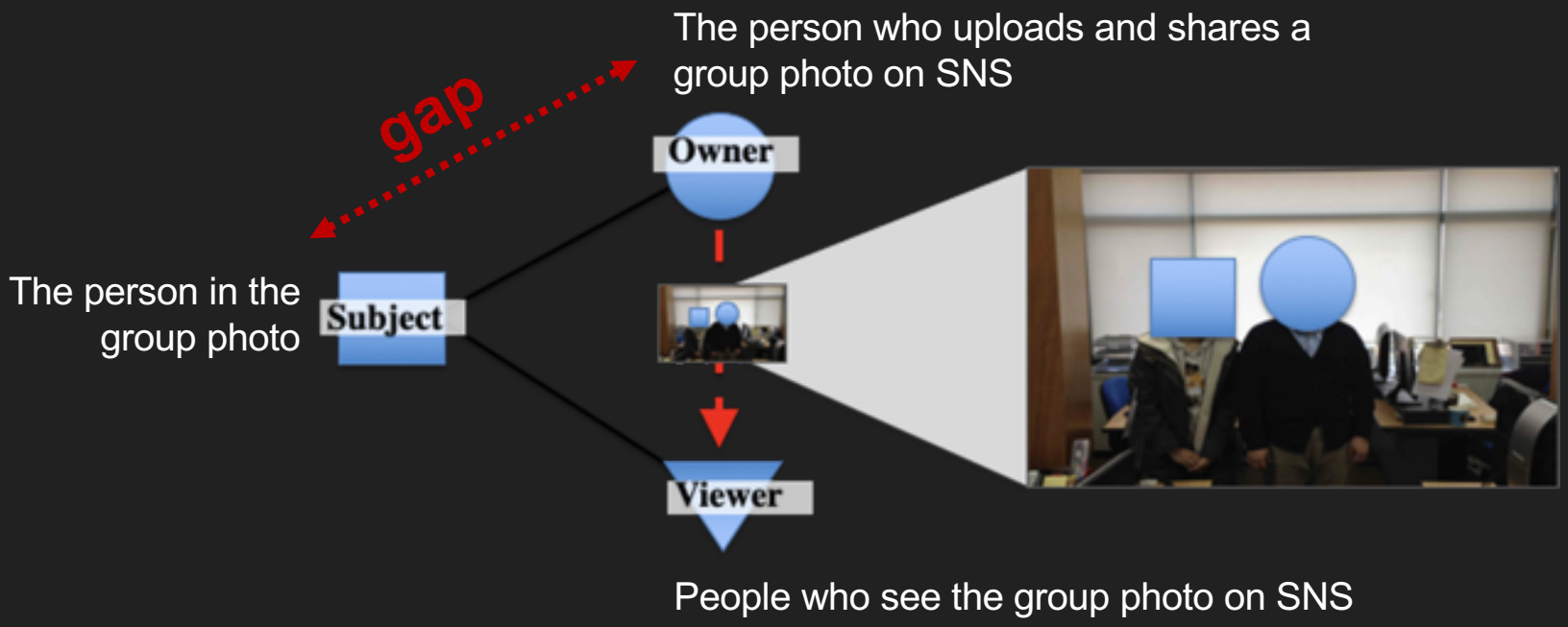
Spending time uploading and tagging group pictures

But, some group photos on SNS may end up creating undesirable digital traces.
Spending time untagging themselves from the pictures

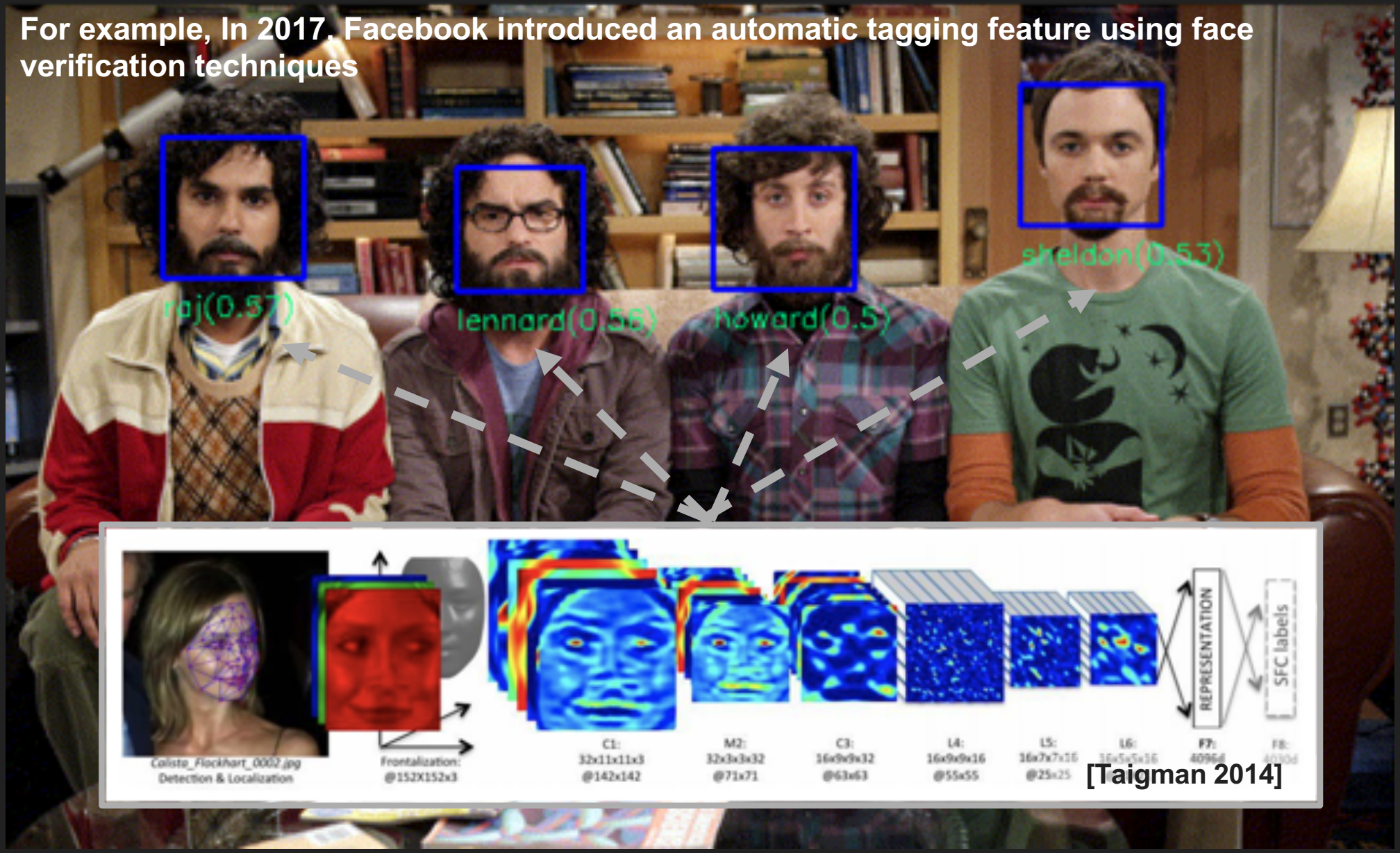
84% of Facebook users had the experience of having their Facebook friends share pictures they did not want to have distributed.

- Besmer 2010 Moving Beyond Untagging: Photo Privacy in a Tagged World. In Proc. CHI 2010, ACM Press (2010), 1563–1572.

Because there is a gap between the sharing preferences of a person who uploads and shares a photo (“owner”) and the person in the photo (“subject”)



The gap will be more problematic. Even worse… automatic tagging



- Taigman 2014. "Deepface: Closing the gap to human-level performance in face verification." Proceedings of the IEEE conference on computer vision and pattern recognition. 2014.

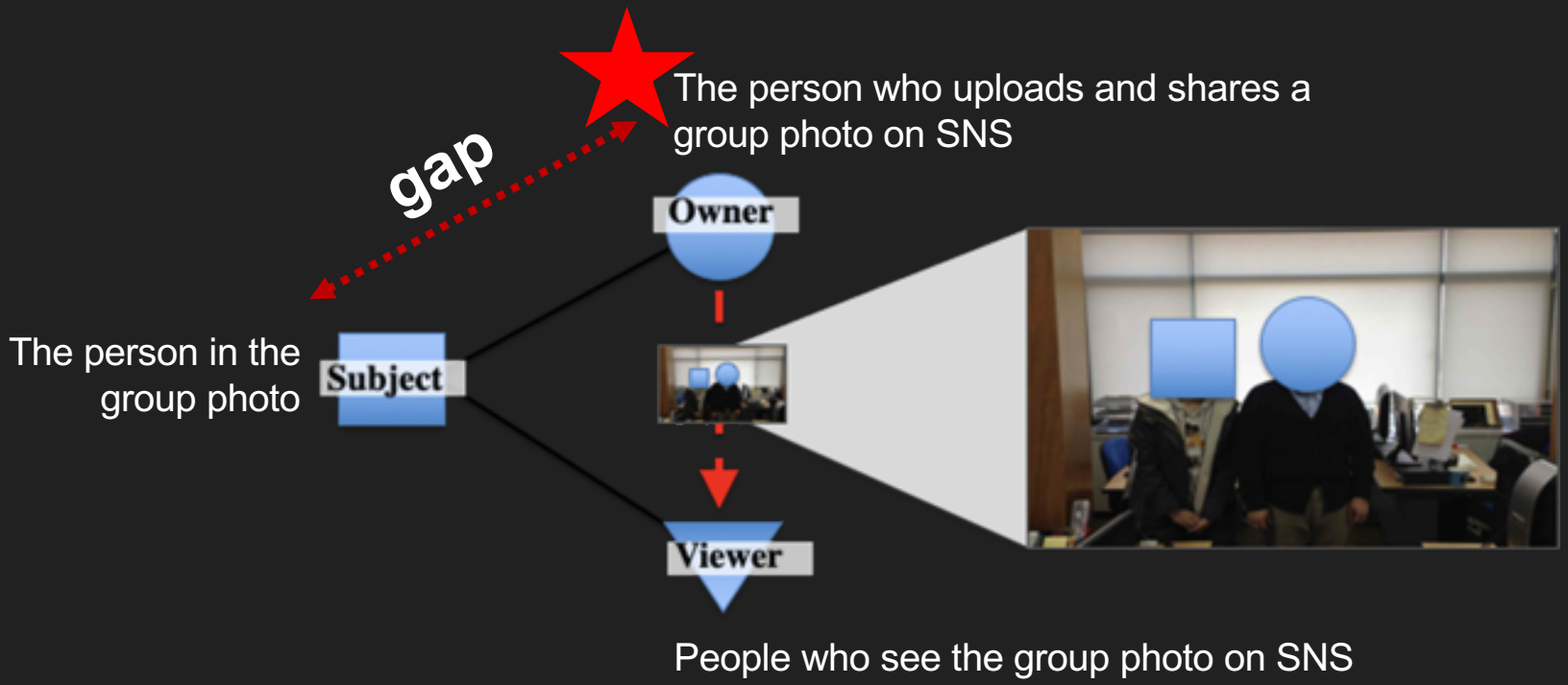
Problem Statement

As support for photo sharing activities increases in SNS systems, privacy concerns emerge as well.

There needs a technology or design that can enable to secure the privacy of “subject” in group photos shared by "owner”.

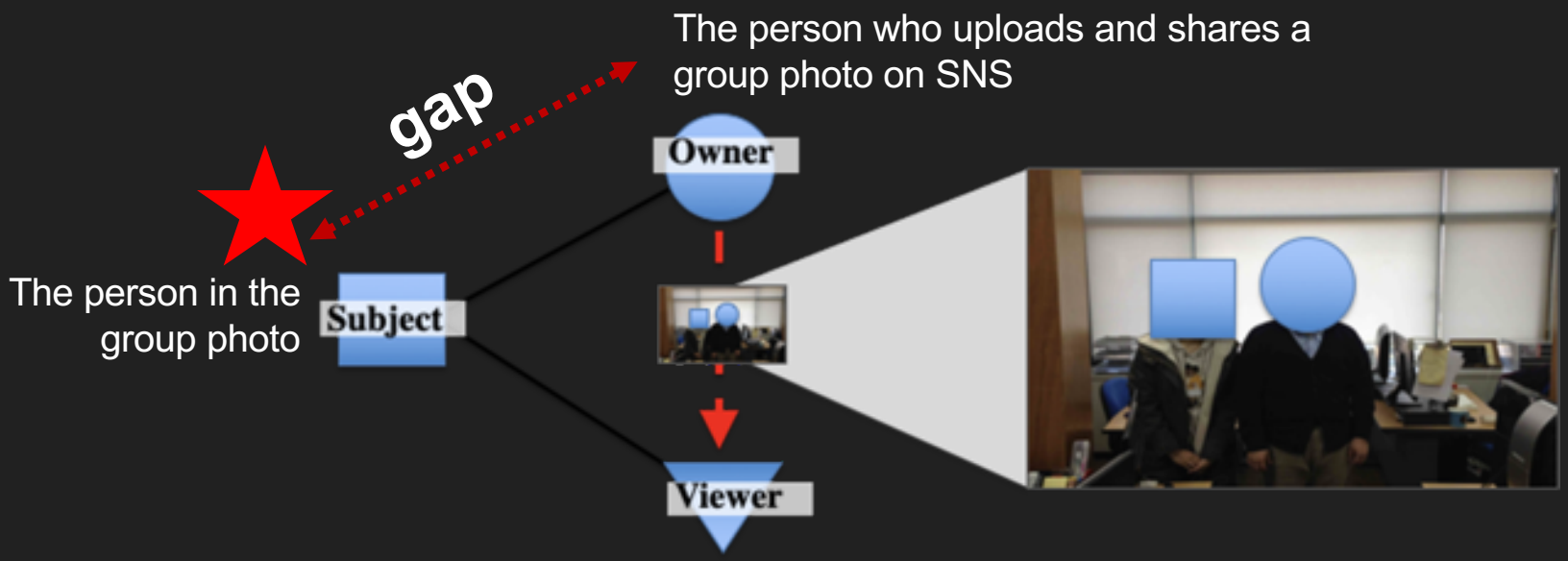
Prior studies have been focusing on photo sharing preference of the owner

[Consolvo 2005, Wiese 2011]



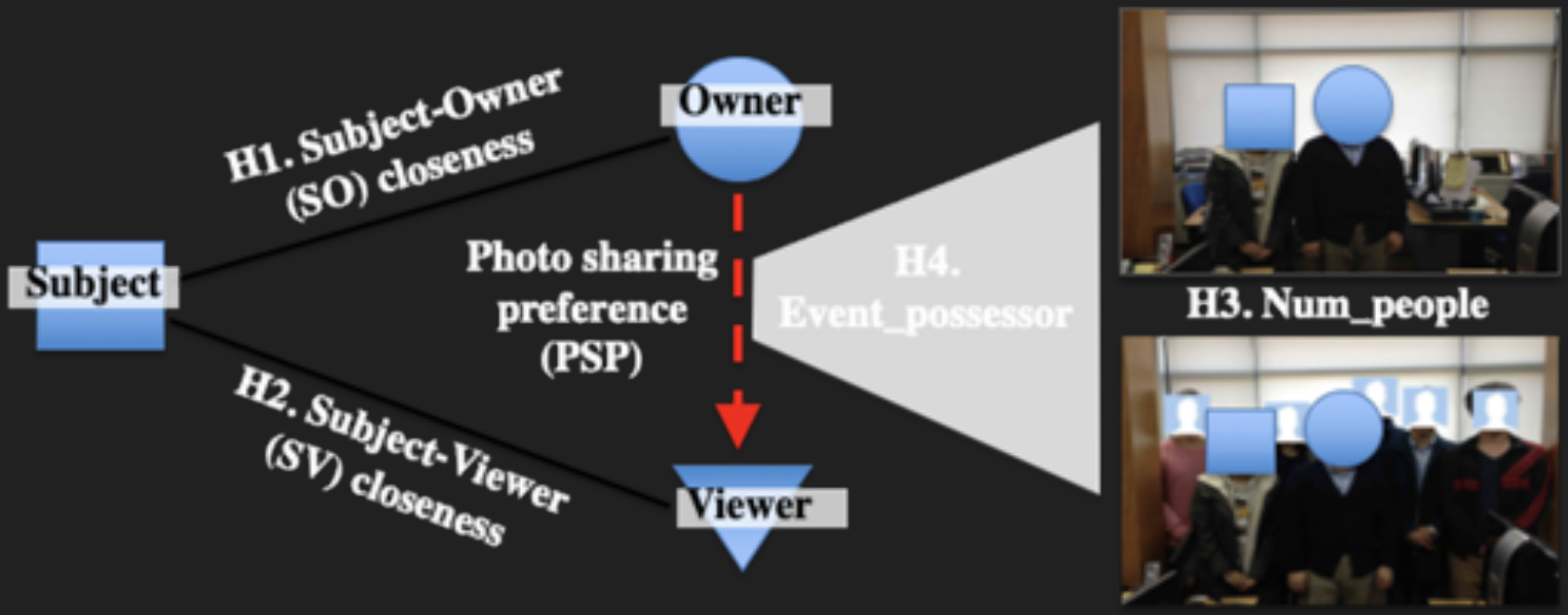
[1] Consolvo 2005. Location Disclosure to Social Relations: Why, When, & What People Want to Share. In Proc. CHI 2005, ACM Press (2005), 81–90.
[2] Wiese 2011. Are you Close with Me? Are you Nearby?: Investigating Social Groups, Closeness, and Willingness to Share. In Proc. UbiComp 2011, ACM Press (2011), 197–206.

This study focuses on photo sharing preference of the subject



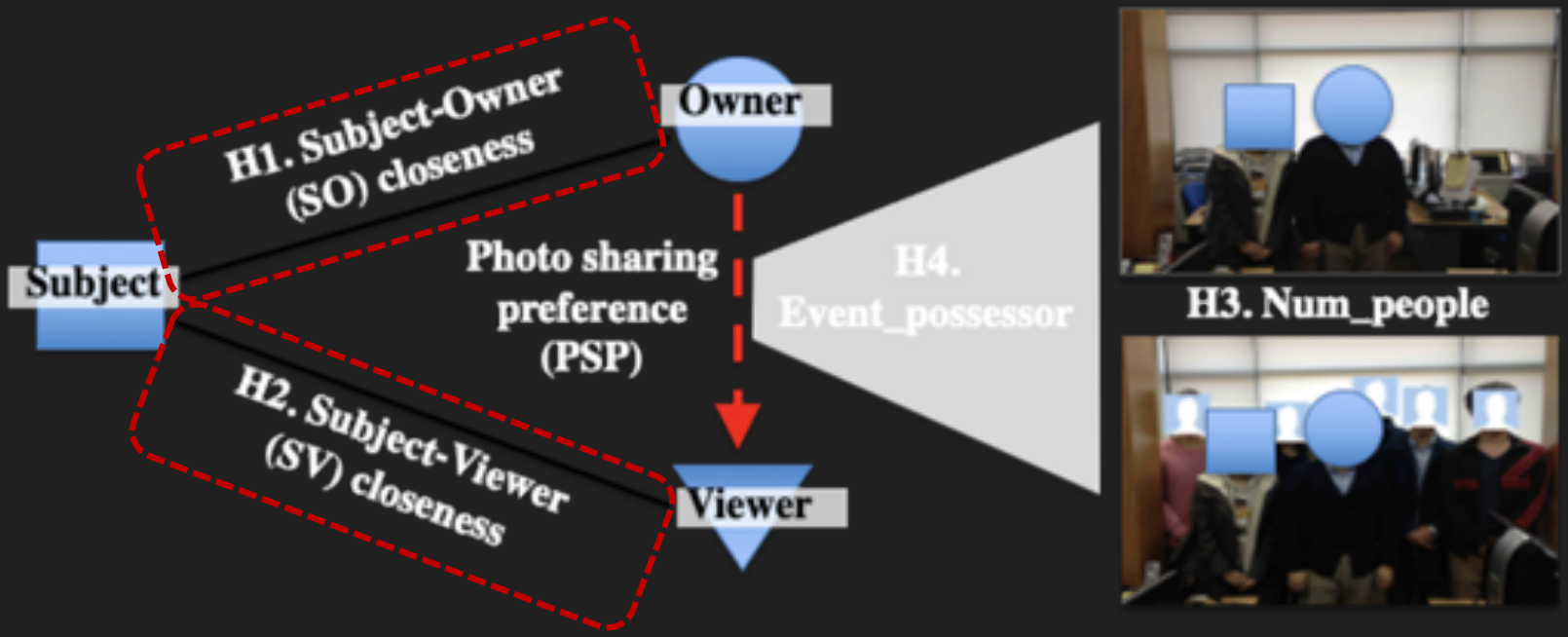
Understanding photo sharing preference (PSP) of the subject

- Research Questions on Closeness and Picture Sharing Preference (H1, H2)
- Research Questions on Ownership and Picture Sharing Preference (H3, H4)



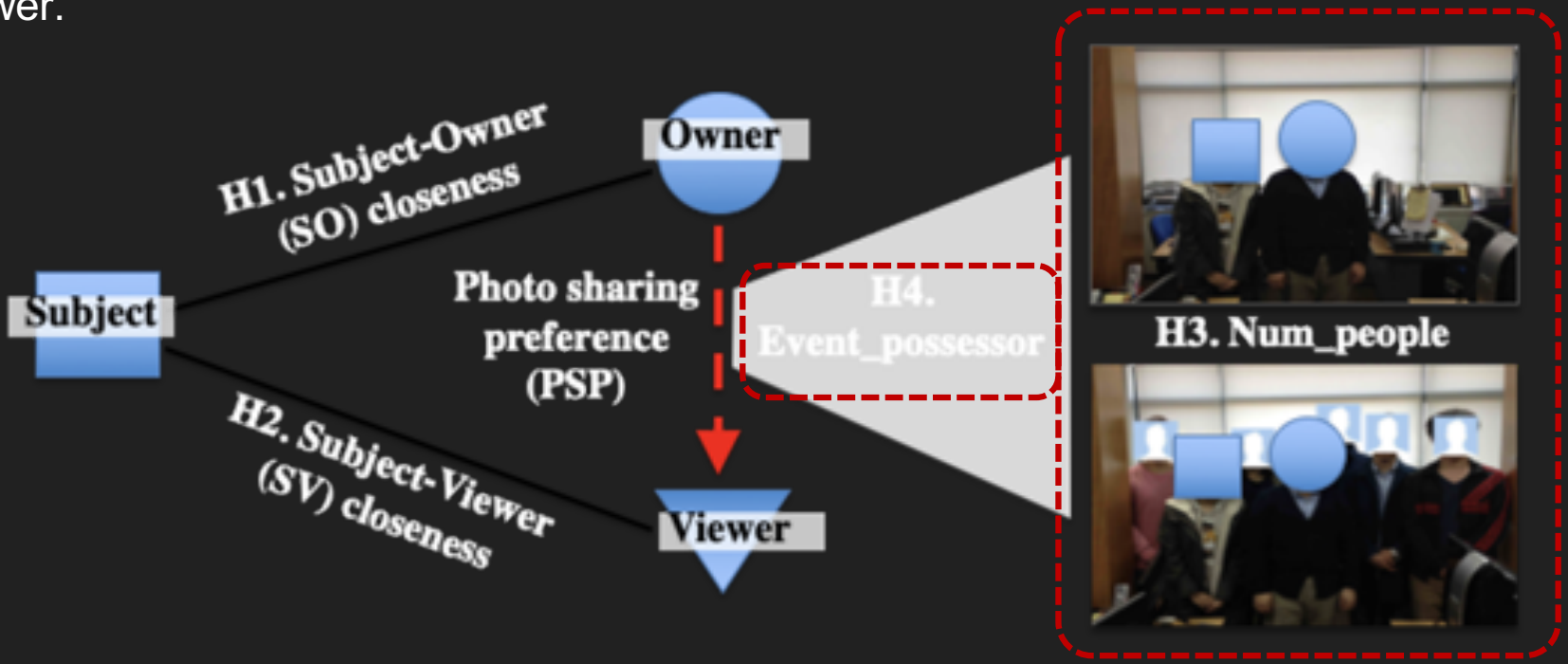
Research Questions on Closeness and Picture Sharing Preference (PSP)

- H1: If subject-owner (SO) closeness increases, a subject's PSP on an owner's picture sharing activity will also increase.
- H2: If subject-viewer (SV) closeness increases, a subject's PSP on an owner's picture sharing activity will also increase.



Research Questions on Ownership and Picture Sharing Preference (PSP)

- H3: When the number of people in a picture increases, a subject's PSP on an owner's picture sharing activity will also increase.
- H 4: A subject's PSP on an owner's picture sharing activity will be lower when the event where photo was taken at is held for the subject compared to when the event is held for an owner or a viewer.



Data collection: Collecting photo sharing preference (PSP) of the subject

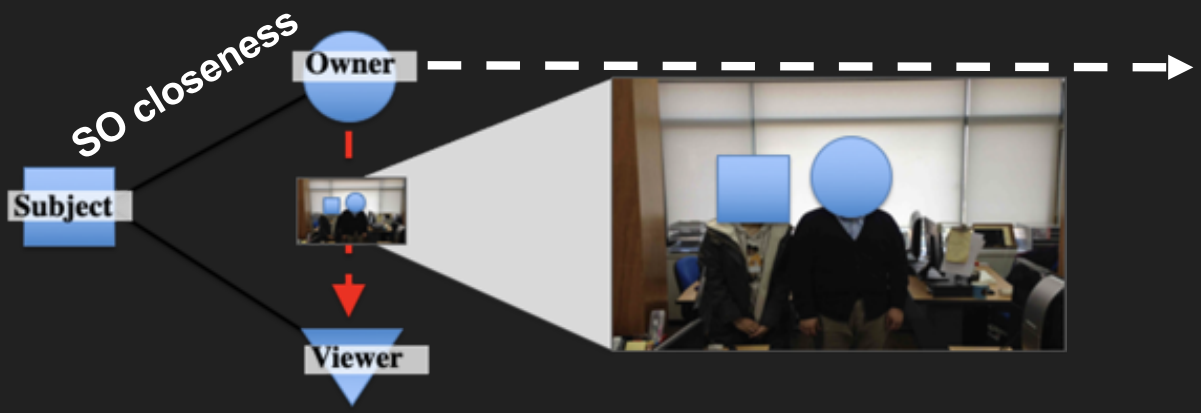
Subject recruitment:

- 29 Facebook users (14 male and 15 females) who have a Facebook account with at least 70 Facebook friends.
- On average, subjects had 435.1 (SD 220.8) Facebook friends. Subjects had been Facebook members for an average of 24.3 months (SD 12.2), and spent an average of 99.3 min (SD 68.5) on Facebook every day.

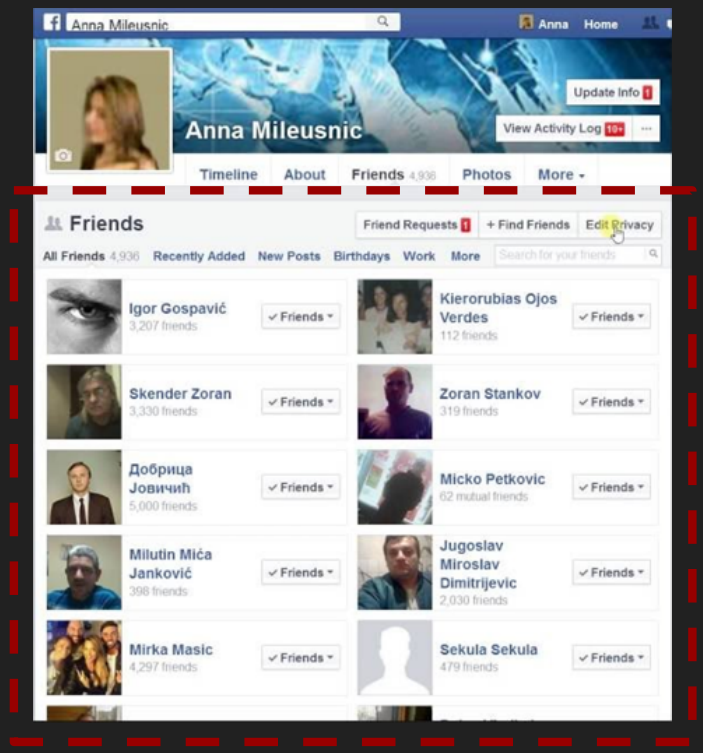
Data collection: Collecting photo sharing preference (PSP) of the subject

Collecting PSP of the subjects

- **Step 1: Measuring SO closeness**
- Step 2: Measuring SV closeness
- Step 3: Indicating photo sharing preferences



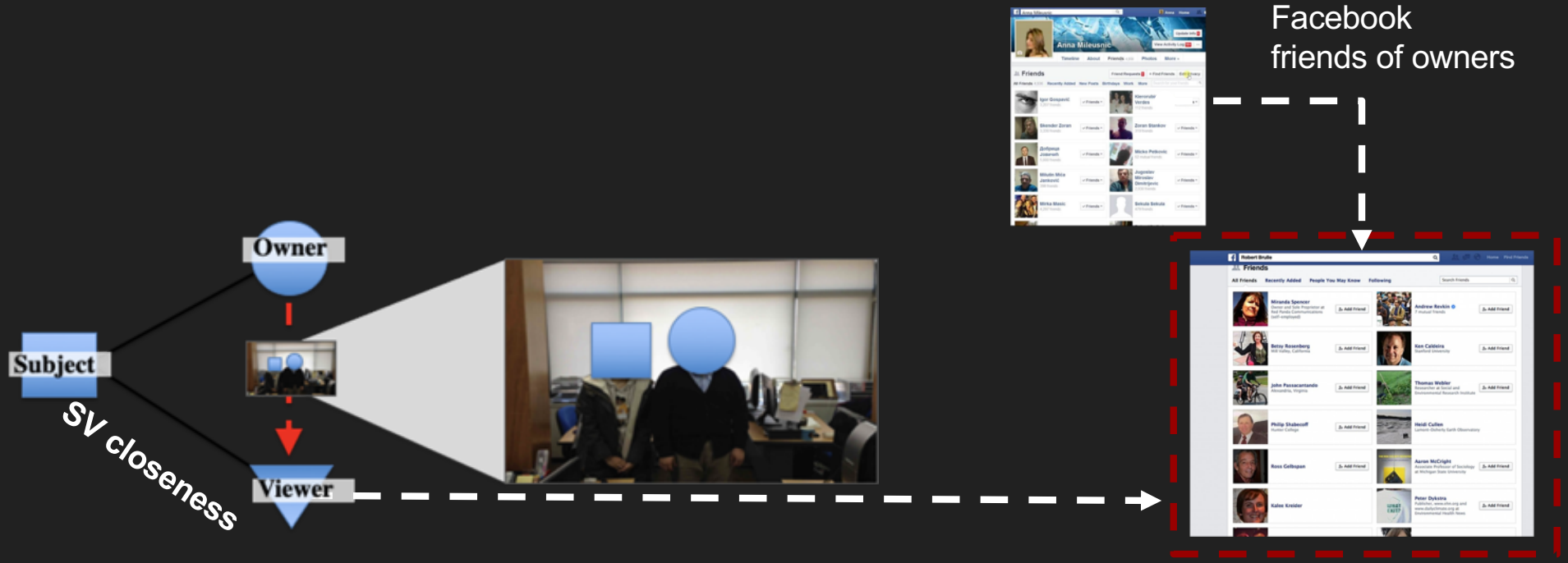
Facebook friends of subjects



Data collection: Collecting photo sharing preference (PSP) of the subject

Collecting PSP of the subjects

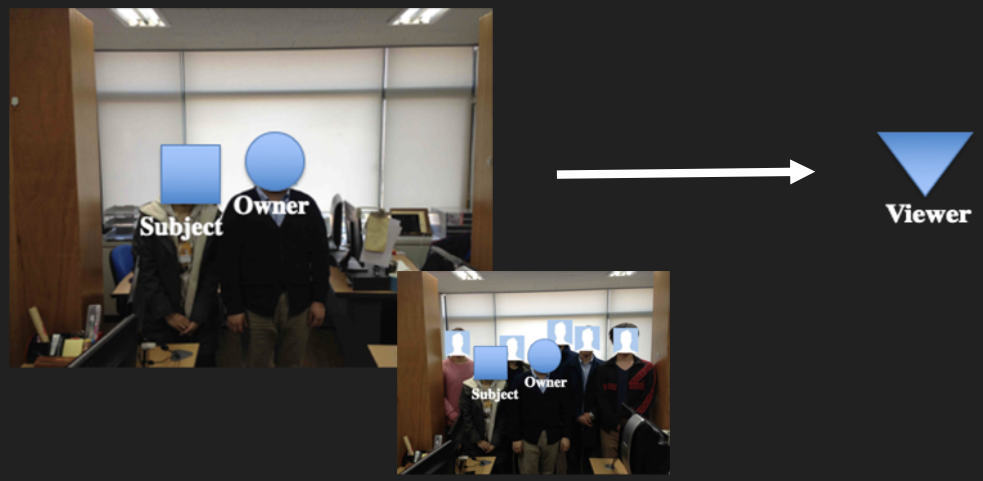
- Step 1: Measuring SO closeness
- **Step 2: Measuring SV closeness**
- Step 3: Indicating photo sharing preferences



Data collection: Collecting photo sharing preference (PSP) of the subject

Collecting PSP of the subjects

- Step 1: Measuring SO closeness
- Step 2: Measuring SV closeness
- **Step 3: Indicating photo sharing preferences towards an owner's act of sharing a group photo containing both the participant (subject) and the owner with a viewer.**



Statistical analysis: Multilevel regression

Assumption check

- Normality assumption: the Shapiro-Wilk Test
- Homoscedasticity assumption: the Wald test

Conducting a multilevel regression with

- Independent variables: SO closeness, SV closeness, number of people on a photo, event_holder
- Dependent variable: Photo sharing preference of the subject
- Random effect (to control for non-independence of the data): Subject

Preventing convergence issues by reducing multicollinearity (Kline, 2015; O'Connell & McCoach, 2008), we applied

- Maximum likelihood estimations
- Grand-mean centering

Results: Research Questions on Closeness and Picture Sharing Preference (PSP)

- H1: If subject-owner (SO) closeness increases, a subject's PSP on an owner's picture sharing activity will also increase.
- H2: If subject-viewer (SV) closeness increases, a subject's PSP on an owner's picture sharing activity will also increase.

Independent variables		Unstandardized coefficients		Standardized coefficients	t	Sig.	95% C.I. for *B*		PRV
		B	Std. error	*β*			Lower	Upper	
Constant		2.49	0.08	n/a	31.54	0.000	2.34	2.65	n/a
Age		−0.10	0.03	−0.20	−3.12	0.004	−0.17	−0.03	0.02
SO closeness	(H1)	0.22	0.01	0.26	27.29	0.000	0.21	0.24	0.08
SV closeness	(H2)	0.36	0.01	0.51	52.87	0.000	0.34	0.37	0.34
SO * SV		0.03	0.00	0.06	6.01	0.000	0.02	0.04	0.01
Num_people(−7)	(H3)	0.14	0.02	0.06	5.91	0.000	0.09	0.18	0.03
Event4Owner	(H4)	0.17	0.03	0.07	6.02	0.000	0.12	0.23	0.05
Event4Viewer	(H4)	0.32	0.03	0.13	11.32	0.000	0.27	0.38	
Num_people * SO		−0.06	0.02	−0.04	−3.75	0.000	−0.09	−0.03	0.02
Num_people * SV		0.01	0.01	0.01	0.53	0.597	−0.02	0.03	
SO * Event4Owner		0.05	0.02	0.03	2.31	0.021	0.01	0.09	0.02
SO * Event4Viewer		−0.02	0.02	−0.01	−0.82	0.414	−0.06	0.02	
SV * Event4Owner		−0.16	0.02	−0.10	−9.35	0.000	−0.19	−0.12	0.02
SV * Event4Viewer		−0.13	0.02	−0.09	−7.99	0.000	−0.17	−0.10	

Results: Research Questions on Closeness and Picture Sharing Preference (PSP)

- H1: If subject-owner (SO) closeness increases, a subject's PSP on an owner's picture sharing activity will also increase.
- H2: If subject-viewer (SV) closeness increases, a subject's PSP on an owner's picture sharing activity will also increase.

Independent variables		Unstandardized coefficients		Standardized coefficients	t	Sig.	95% C.I. for *B*		PRV
		B	Std. error	*β*			Lower	Upper	
Constant		2.49	0.08	n/a	31.54	0.000	2.34	2.65	n/a
Age		−0.10	0.03	−0.20	−3.12	0.004	−0.17	−0.03	0.02
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Results: Research Questions on Ownership and Picture Sharing Preference (PSP)

- H3: When the number of people in a picture increases, a subject's PSP on an owner's picture sharing activity will also increase.
- H 4: A subject's PSP on an owner's picture sharing activity will be lower when the event_possessor is the subject compared to when the event_possessor is an owner or a viewer.

Independent variables		Unstandardized coefficients		Standardized coefficients	t	Sig.	95% C.I. for *B*		PRV
		B	Std. error	*β*			Lower	Upper	
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Results: Research Questions on Ownership and Picture Sharing Preference (PSP)

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SO * Event4Viewer		−0.02	0.02	−0.01	−0.82	0.414	−0.06	0.02	
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SV * Event4Viewer		−0.13	0.02	−0.09	−7.99	0.000	−0.17	−0.10	

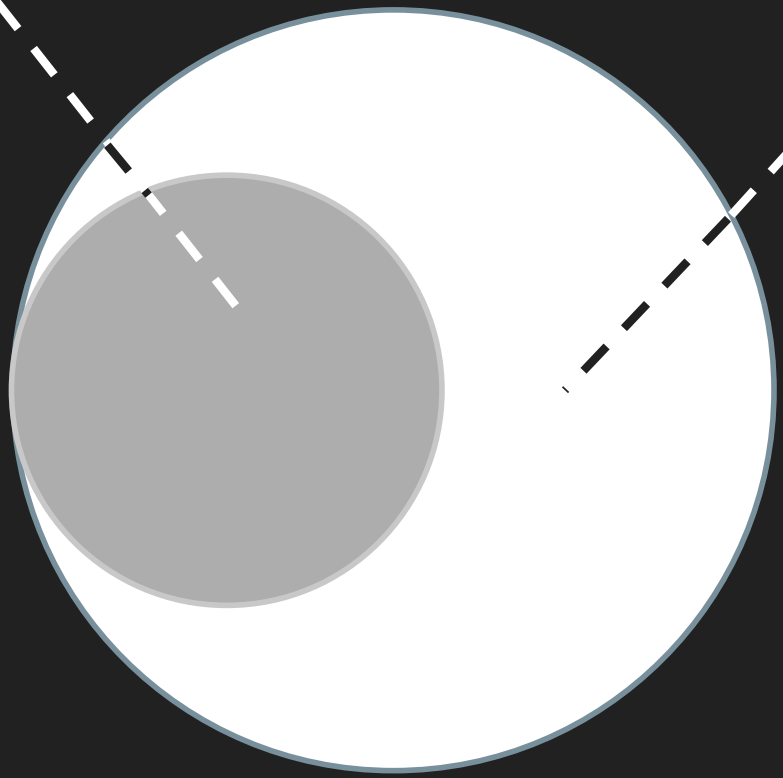
Picture Sharing Preference (PSP) classification

Classification based on Subject information
(age and gender)

$R^2 = 0.16$

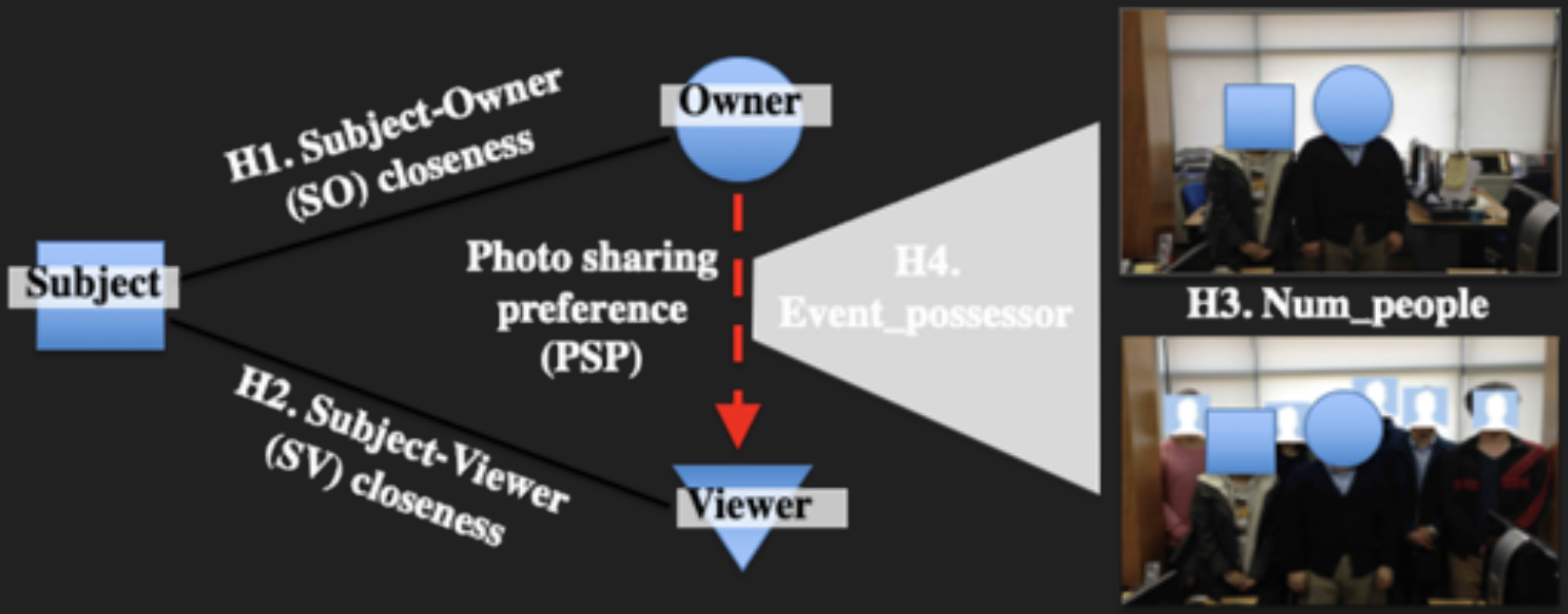
Classification based on all information
(Subject age and gender, SO and SV closeness, number of people in a picture, ownership perception):

$R^2 = 0.52$



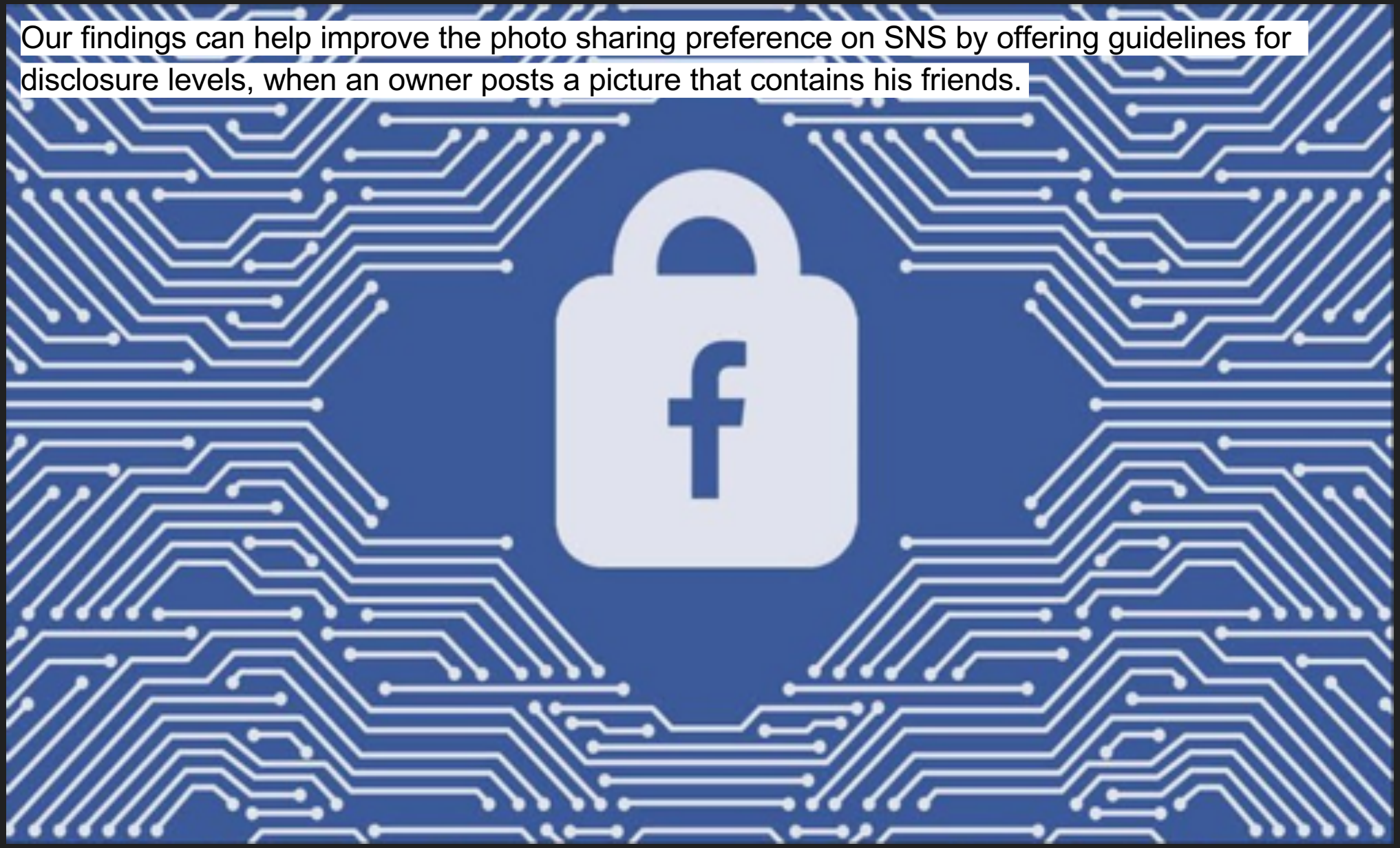
Discussion and Implications: Summary of findings

Our study shows that closeness (SO and SV closeness), perception of ownership, and the number of people in a group photo are important factor to estimate photo sharing preference of subject.



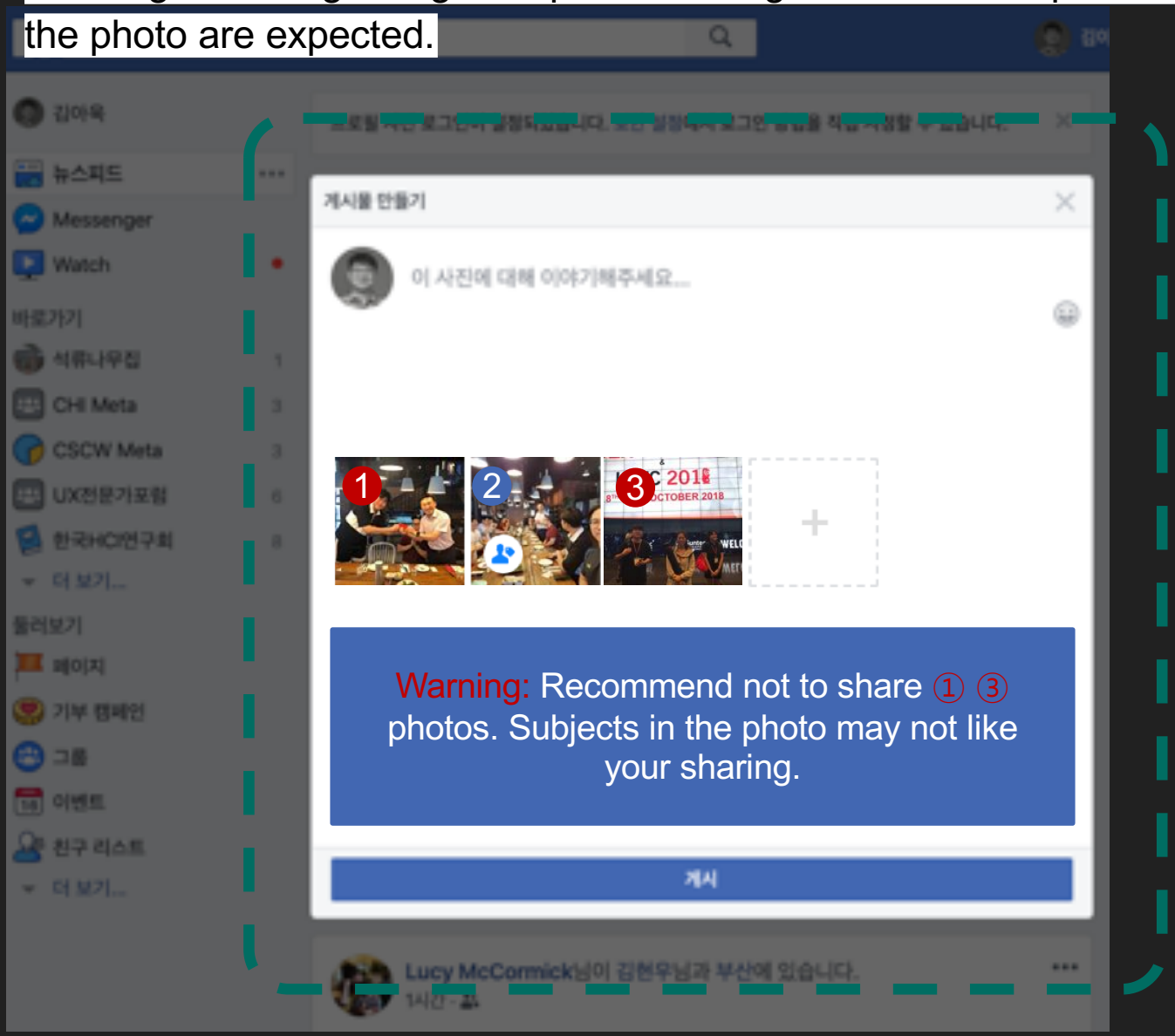
Discussion and Implications: Design guidelines

Our findings can help improve the photo sharing preference on SNS by offering guidelines for disclosure levels, when an owner posts a picture that contains his friends.



Discussion and Implications: Design guidelines

Warning users regarding their photo sharing if low levels of photo sharing preference for subjects in the photo are expected.

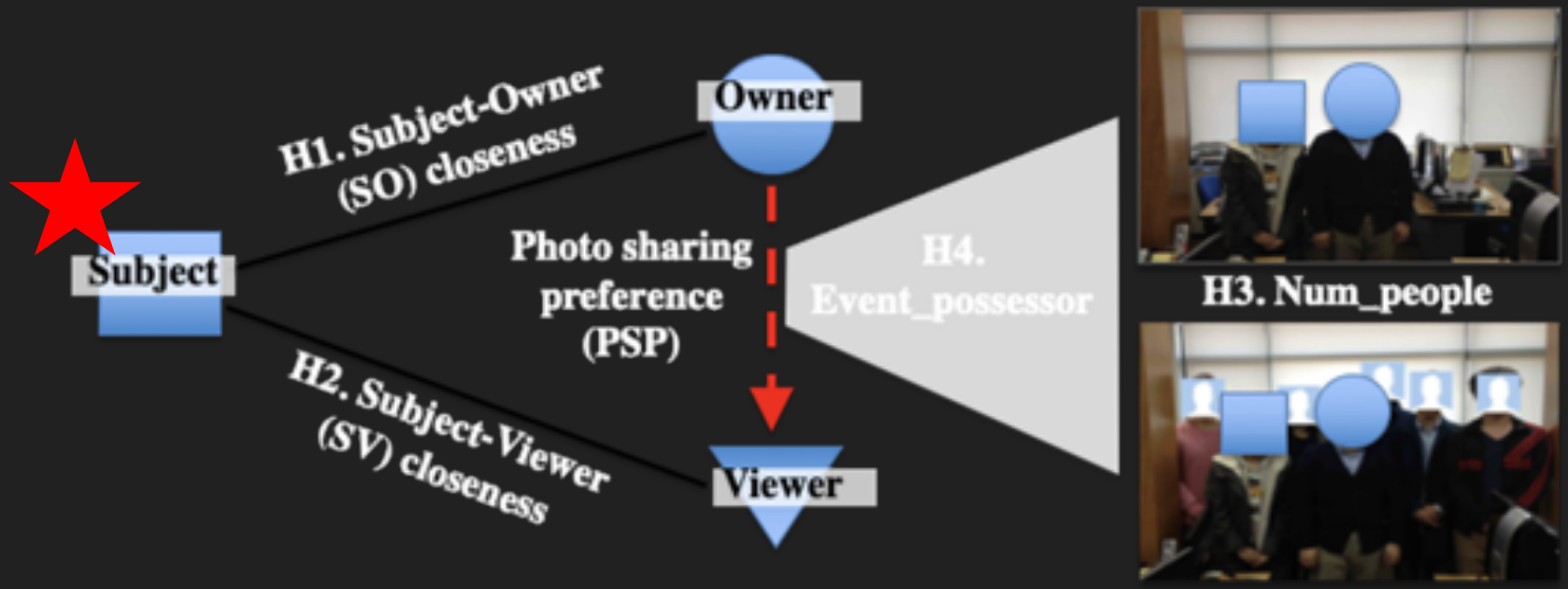


Discussion and Implications: Generalizability of findings

Our findings are not limited to picture sharing activities. They can be extended to general information sharing practices, for example, location, video, even for web-cloud sharing (Dropbox, Google drive).

Conclusion

Our study presents a first step toward improving the experience of subject for photo sharing on SNS.



Study 3: Sensors Know Which Photos Are Memorable

Kim S, Patra K, Kim A, Lee G, Segev A, Lee A. "Sensors Know Which Photos Are Memorable." In Proceedings of the 2017 CHI Conference Extended Abstracts on Human Factors in Computing Systems (CHI '17 Works-in-Progress). ACM (2017).
*I was a research mentor

Too many photos taken during travels, but never looked at again.

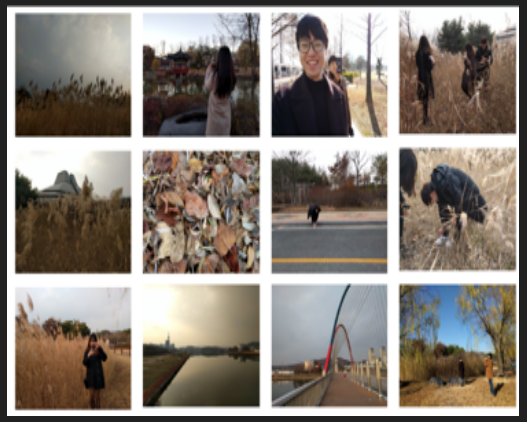
Which of these photos should I upload?

Problem statement and study goal

There is a strong desire to find memorable photos that are worth sharing via social media such as Facebook and Instagram, or to automatically shuffle memorable photos to help people reminisce about important life events.

In this study, we investigates how to automatically detect memorable photos based sensor data collected by smartphone and wearable devices.

Study Procedure



Taking photos
(304 photos by 11 participants)

Rating program

Rating memorability of photos

Building a machine learning model for memorability classification

While tasking photos, collecting photo and sensor data

Microsoft band 2

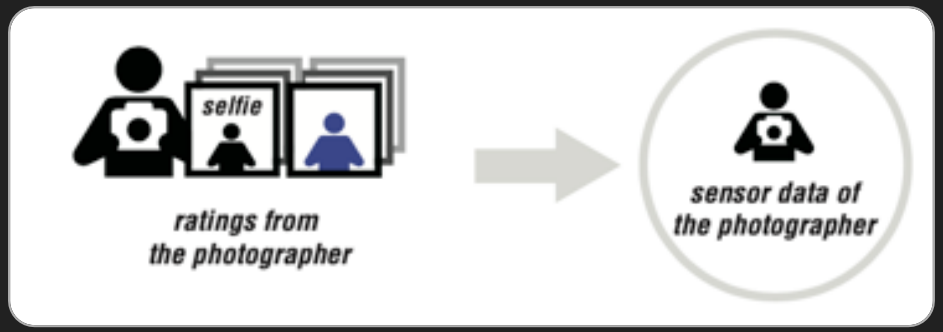
Sensors
Optical heart rate sensor
3-axis accelerometer/gyro
Gyrometer
GPS
Ambient light sensor
Skin temperature sensor
UV sensor
Capactive sensor
Galvanic skin response
Microphone
Barometer

Results of statistical analysis (Multi-level regression)

Photographer Focused

The sensor data of the photographer is analyzed with the ratings from the photographer; these could be selfies or photos of others.

β =-14.777, p < .001

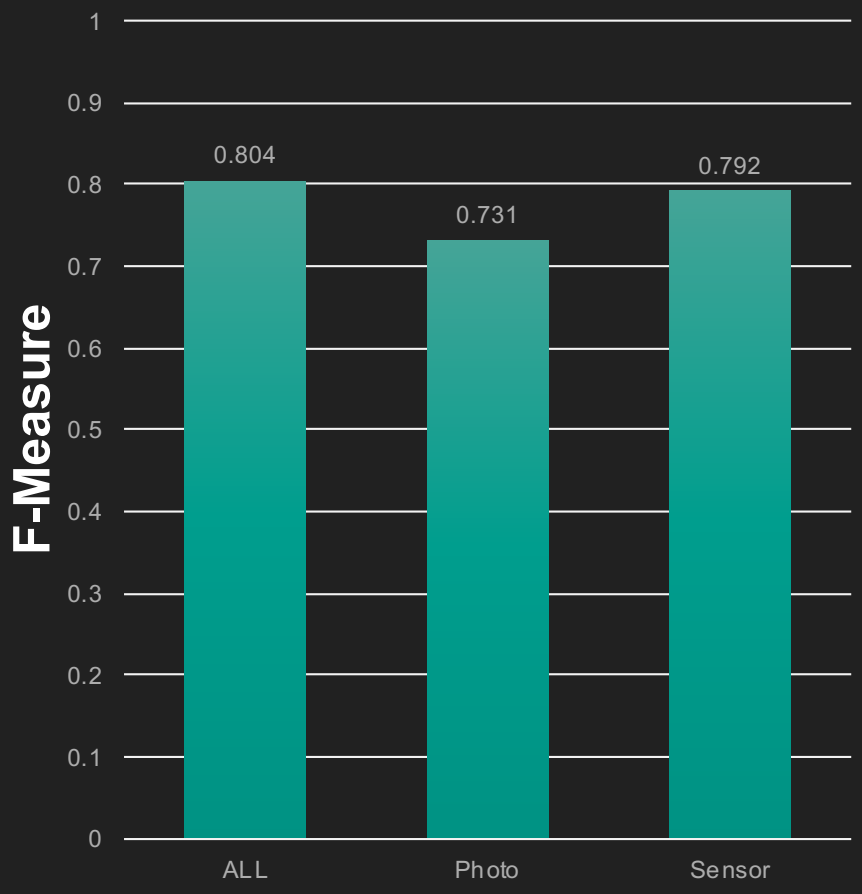


Subject Focused

The sensor data of the photographer is analyzed with ratings from the subject in the photo. Subject focus was used to determine if a photographer's biological signals could be used to infer the memorability and emotions of subjects in the photos.

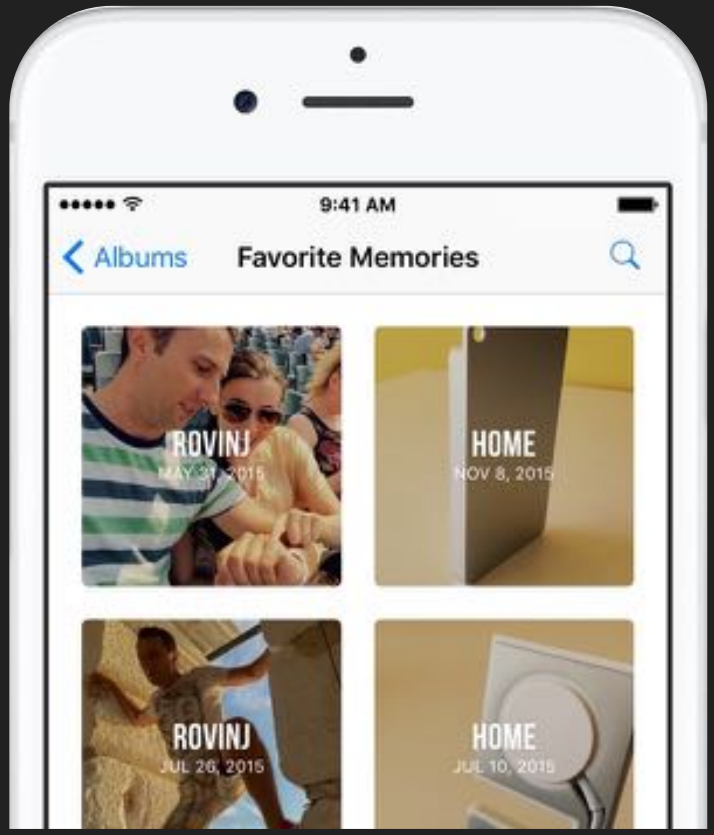
β =-7.563, p < .05

Results of machine learning model analysis



Implications

Memorability classifier can be used for automatic selection of representative photos for photo albums



Memorability classifier can be used for photo suggestions for SNS.