

# The Consumption of Integrated Social Networking Services on Mobile Devices

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## ABSTRACT

Some mobile devices automatically fetch content from social networking services and integrate it into the device user interface. In this paper, we explore how people consume integrated social networking services in a field study with an innovative aggregator named Linked Internet UI Concept, or LinkedUI. Twenty users completed the field study. We logged their activities and performed user interviews. The study reveals two main use cases: *habitual checking* where users frequently glanced at the integrated services at short intervals; and *serendipitous content discovery* where they come across some content when performing other tasks. The study also reveals that the users only attended to a small proportion of the full content set, such as content recently published and content from selected contacts. This indicates the user need of quick access to relevant content.

## Categories and Subject Descriptors

H.5.2 User Interfaces: User-centered design.

## General Terms

Measurement, Design, Experimentation, Human Factors.

## Keywords

Social networking services, social network aggregator, mobile, aggregation, integration, notification.

## 1. INTRODUCTION

Mobile devices automatically fetch and report new events, for example, in text messaging and push email. This principle is lately seen in the systems that deliver social networking services to mobile devices, for example, in Motorola's Motoblur [4], Vodafone 360 People Menu, HTC Friend Stream, and Microsoft Windows Phone 7 People Hub. These mobile social network aggregators often combine content from multiple services into a single location and integrate the content into phonebook and home screen [3, 9]. The content objects from social networking

services, or the social awareness streams [22], are readily available for the users. They do not have to intentionally seek for the new content, nor do they need to make much effort to locate it [30].

Some initial user studies have explored how people accept mobile social network aggregators. *Universal inbox* combines emails, text messages, RSS feeds, Twitter and Facebook updates. People like the design principle and are able to use *Lenses* to control the collections of all items [28]. A laboratory study with *LinkedUI* suggests that users appreciate the possibility to glance at everything in one overview [9]. Neither of these studies, however, collects sufficient data to analyze how people consume integrated social networking services. For example, *how often do users visit the integrated services, from what views do they visit these services, and what content do the users pay attention to?*

In this paper, we deployed LinkedUI and used it as a vehicle to explore how people consume integrated social networking services on mobile devices. Different from common mobile social network aggregator, LinkedUI uses *hypertext navigation* to organize all its functions, including social networking services and other mobile applications such as contacts, text messages, and emails. For example, there are hyperlinks between any content and the identity who published it, and vice versa. Through these hyperlinks, content can be presented in *any* views that are logical for users, such as the home view, the activity stream view, the contact views, and the search view. In LinkedUI, the level of service integration is deeper than in the existing solutions where the content resides in application silos [10], and the integration is often limited to phonebook [1] and home views [4].

In this paper, we report the findings from a field trial with LinkedUI. 20 users used LinkedUI as one of their primary phone for 4 four weeks. We gathered the usage data with on-device logging, and collected their opinions through user interviews. A small number of participants were recruited for this study because we aimed to gather in-depth objective and subjective data from individual users. In addition, LinkedUI introduced a new user interface system for the whole device, which made it technically hard to distribute it as an application for a larger public user trial.

The key contribution of this study is to characterize activities of consuming social networking services on a mobile aggregator. The *consuming* behavior, from both mobile and stationary terminals, is not well explored as "visible" publishing behavior such as relationship articulation and status updating activities. The consumption is more difficult to capture compared with publishing activities [3, 19, 27].

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## 2. LITERATURE REVIEW

Mobile devices have emerged as essential tools to access social networking services. Naaman and colleagues report that 25% of all social networking content items are generated from a mobile platform [22].

Social network aggregators fetch content from social networking services and present it in one user interface. When experimented in mobile devices, they also support in-depth integration. *Universal inbox* combines emails, text messages, RSS feeds and Twitter and Facebook updates, and allows people to create *Lenses* in order to control the collections of all items [28]. *Motoblur* combines Facebook, Twitter and text messages for each contact into phonebook. The related research is published as a project named *Contact 3.0* [4]. Other commercial social network aggregators include *Palm Pre Synergy*, *Vodafone 360*, *HTC Friend Stream*, and *Microsoft Windows Phone 7 People Hub*. These social network aggregators empower readers to combine multiple services and link the identities of the publishers who can still keep separate identities for different audiences. These systems differ from publisher initiated aggregators, for example, *FriendFeed* website, where the publishers merge their identities, and generate one unified presentation for all their readers.

In our literature review, we found limited user behavioral study on mobile social network aggregators. Sohn and colleagues conducted an informal field study of *Universal inbox* and *Lense* concepts with five users [28]. We earlier reported a laboratory study on an earlier version of LinkedUI [9]. Both studies reveal that people appreciate the ideas of auto-fetching and aggregating services on mobile devices, but neither study gathers sufficient data to analyze usage patterns. Due to the lack of research on these applications, we expand the review to cover relevant systems in the following sections.

### 2.1 User Studies with Relevant Systems

Mobile social software applications do not involve social networking services, but the related research provides some background studies about aggregation designs.

Some studies explore notifying users of new events in real time. For example, *Dodgeball* is a mobile social networking service that allows people to broadcast their locations via text messages to their articulated networks. The users meet up with friends who just happen to be nearby or are available to join [18]. This design resembles the key feature in mobile social network aggregators to notify users of new content in social networking services. A user study with *Dodgeball* shows that the real-time notification facilitates serendipity; however, the frequent notifications may compromise the text messaging experience. The users may feel overwhelmed by the amount of interruptive notifications [18].

Some mobile social applications explore augmenting mobile phonebooks with presence information. *ContextContacts* [23] integrates contextual cues into mobile phonebook. Field studies with the concept show that people feel better connected to their contacts through observing the contextual cues. This study supports the value of integrating services into native mobile functions. People use awareness cues as a coordination tool, expression medium, and companionship proxy. They support connectedness feeling, and help people to maintain perpetual contact with others. *Motion Presence* [6] augments phonebook

with motion information, which allows people to view each other's motion status. The user study shows that *Motion Presence* helps infer locations and activities and to plan communication. It helps in coordinating in-person get-togethers, and to stay connected to each other. *Friendlee* integrates some social information into mobile phonebooks, to provide users with ambient awareness of their social network. This concept analyzes the user's call and messaging activity to form an intimate social network, presuming that people mostly want to interact with their close relationships [1].

### 2.2 Consuming Activities in Social Networking Services

People use social networking services, Facebook in particular, to see what old contacts and friends are up to, but they seldom use it to initiate new connections [20, 21]. These activities reflect their desires for "checking up on regularly", or keeping "perpetual contact". Facebook's news feeds feature fits this user need well [20]. Via mobile devices, users continuously refresh their email inboxes and social applications, yet they refrain from engaging in mutual exchanges due to usability limitations [26].

*Consuming* activities, such as browsing Facebook profiles, account for majority of all user activities [3, 19]. However, they are not well explored due to their absence in publicly available data. China's Renren is an exceptional service that makes friendship and partial reading history public [19]. Its transparency policy may restrict the generalization of the findings. Studies with other services rely on detailed click streams, for example, Orkut, MySpace, Hi5, and LinkedIn are studied in [3]; Facebook, LinkedIn, Hi5, and StudiVZ in [27]. These studies reveal that the consuming activities occur more frequently and involve a bigger social network than publishing activities [3]. The most common examples are browsing home page and profiles [27]. Each session of these consuming activities lasts for a longer period of time when involving media content such as photos and videos [3]. These large scale user studies reveal the patterns of micro-level user activities. One limitation is that these usage patterns are not further explored through interviewing individual users.

In summary, social network aggregators become popular, but there are few user studies about them in mobile contexts. In particular, there is limited literature about how people consume social networking content through them. This paper is aimed to fill this gap. We explore how people use them through log data analysis and ground the usage patterns through user interviews.

## 3. LINKED INTERNET UI CONCEPT

LinkedUI is a device user interface system deployed on a Nokia N900 phone. It supports Facebook, Twitter, and Flickr, Gmail, phonebook, voice call, text messaging, and web browsing functions. Once turned on, the device automatically launches LinkedUI and hid N900 native system.

LinkedUI is an innovative mobile social network aggregator. It constantly pulls content from Facebook, Twitter and Flickr at short intervals, and notifies users of new content. As a novel feature, LinkedUI uses hypertext navigation as a replacement for application silos. Social networking content can be accessed via *any* view that it is logical for users. These views are generated on the basis of the associated metadata and hyperlinks between content items. Figure 1 depicts some key views in LinkedUI and

hypertext navigation between them. The design principle is reported in [9], but the views are modified based on our learning from the previous studies.

As depicted in Figure 1a, the *home view* contains a notification area that presents the three latest items from integrated social networking services. Above the notification area, the view provides access to updates (social awareness streams from all services), inbox (text messages, email and directed messages), and calls. The LinkedUI home view follows the same design principle as any other views. A user can directly interact with individual items from this view. This differs from some home view widgets that serve as application launchers.

In the *activity stream view* (Figure 1b), recent updates are combined across multiple services and listed in a reverse chronological order. The design intention is to help the user to keep up to date on recent updates without visiting the services separately. The *service views* are listed as tabs available for advanced users to check individual service.

In the *contact view* (Figure 1c), update streams are organized by individual contacts across services. LinkedUI retrieves a user's contacts from all services and automatically matches identities based on unique identifiers such as name and email address. It also suggests the possible identities when the user manually link identities to create unified contacts.

In the *item view* (figure 1d), a user can check the details of an item and the other relevant items. For a status update, the user can read the entire conversation around the update, including comments

and likes. For a photo, the user can check comments about the photo, and navigate to other photos in the same album, uploaded in the same time, or geo-tagged with the same location.

## 4. USER STUDY

This paper reports a 4-week field trial with LinkedUI. The study was carried out between Aug–Dec 2010 in Southern Finland.

### 4.1 Participants

20 people (16 male, 4 female) completed the study. They were 19 to 46 years old ( $M = 34.15$ ,  $SD = 6.71$ ), living and working in Tampere or Helsinki regions in Finland. As criteria to participate, each of them needed to have at least 90 Facebook friends and check them once a day or more via mobile devices. Actively using Flickr and Twitter was considered a benefit. Each user received a 50-euro gift card after completing the study.

The participants were recruited through four mailing lists. These mailing lists were about new mobile devices and web services, and volunteering for user studies. 12 participants came from technology backgrounds, working as software developers, hardware technicians, and project management. 8 users came from non-technical backgrounds, working in financial, marketing, and assistant positions. The participants in this study were all working in the same corporation because of our agreement with the tested social networking services companies.

All the study participants were active social networking service users. Figure 2 shows the number of contacts each user had, and the average number of items each user received every day during

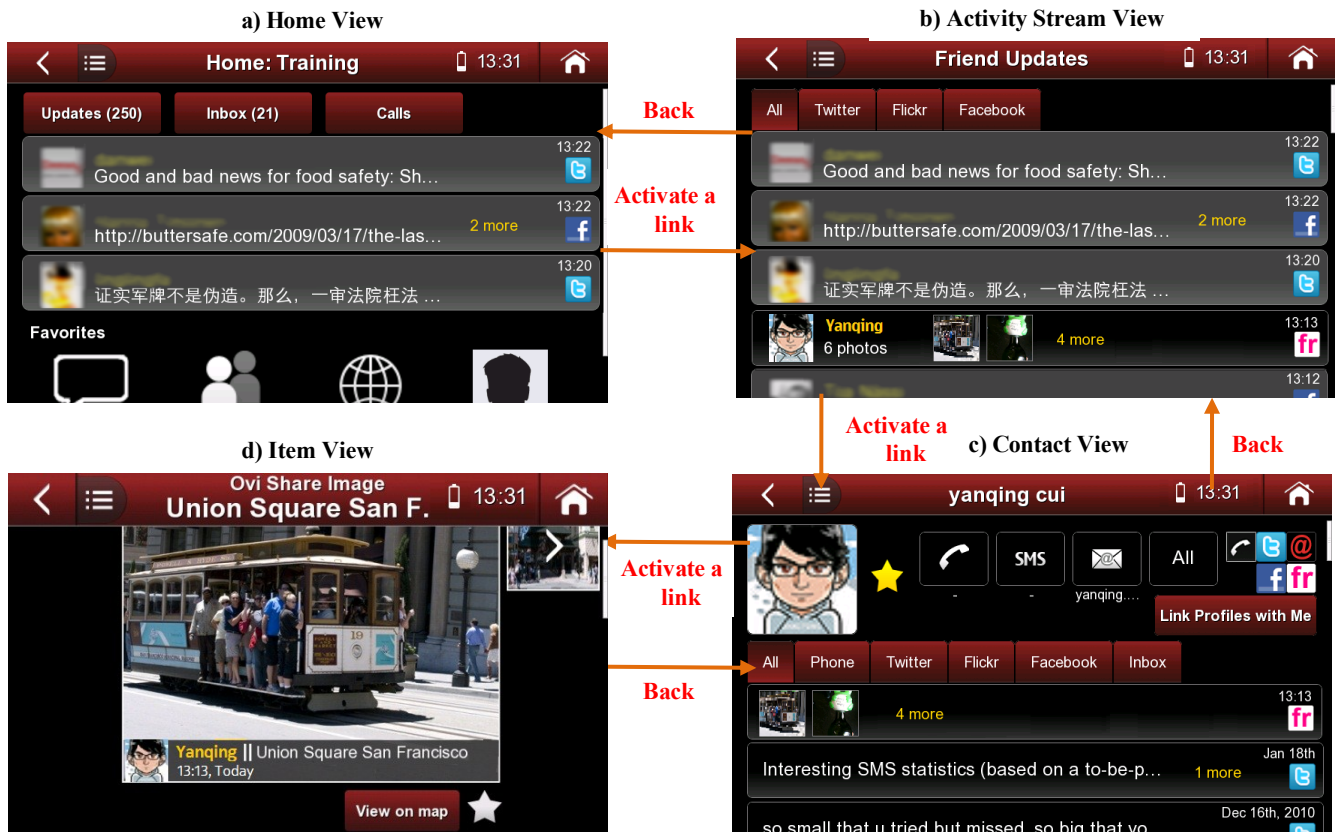
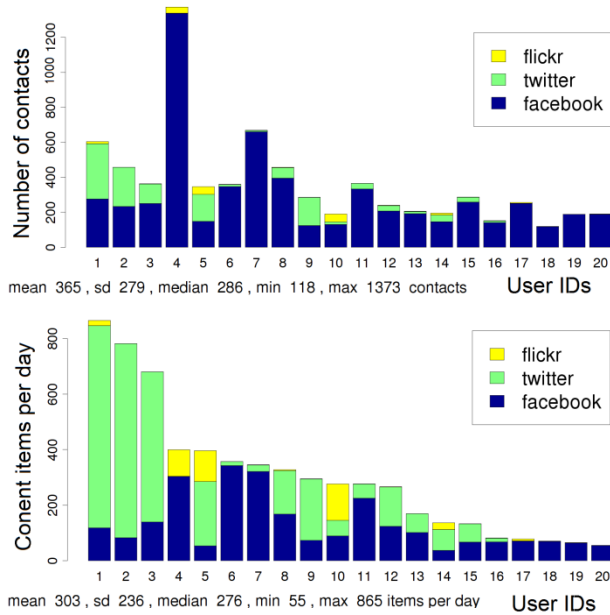


Figure 1. Key LinkedUI views and hypertext navigation between them.

the study. A typical user had 286 contacts, and received 276 items a day (medians). The information volume received varied a lot between users, ranging from 55 to 865 content items per day ( $M=303$ ,  $SD=236$ ). Twitter produced much more data per contact than Facebook. For example, in Figure 4, the leftmost three users had fewer contacts, but received more content on Twitter than on Facebook.



**Figure 2. The number of contacts each user had (above), the average number of items each user received a day (below).**

## 4.2 Procedure

The users loaned a N900 with pre-installed LinkedUI for test. They were encouraged to use it as their primary phone for all the supported functions during the four-week-long study. All users subscribed to a MultiSIM service that supported two SIM cards sharing one number. We chose this setup because LinkedUI did not support some common smart phone functions, such as calendar, camera, or GPS navigation, in this study. People needed other devices for these functions.

We met each individual user face to face twice during this study. The first meeting was to set up LinkedUI devices. Some key tasks included: general introduction to the user study, handing out the test devices, signing the user data consent agreements, and setting up the test devices (downloading phone books from the users' current devices, entering credentials for the integrated services, configuring logging software, and performing the first data fetching). The second meeting was organized by the end of the study. The main tasks were to collect user comments through semi-structural open-ended interviews, remove user's data, and recall the loaned LinkedUI devices.

## 4.3 Data Gathering and Analysis

The logged data was gathered by automatically uploading it to a server. For each individual user, we tracked the fetched content from all the integrated services and its metadata (time, contacts, services), user actions with these items (clicked or not) as well as all views the users visited. All these logged data was anonymized,

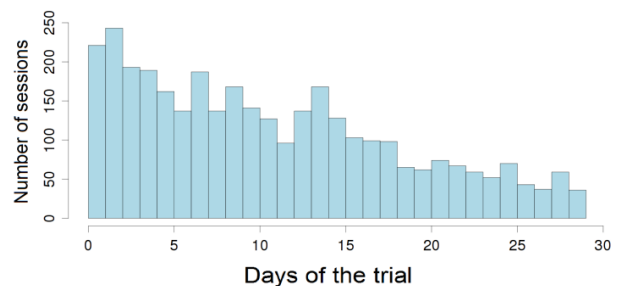
and upload into a server every 12 hours. In this paper, the analysis of logged user data focus on the top 13 active users unless mentioned otherwise. They used LinkedUI for 14 or more active days. In an active day, a user needed to click at least one item. Other seven users (User 2, 5, 6, 7, 17, 18, and 19), are not covered in the log data analysis because they used LinkedUI for fewer than 14 active days.

All the 20 participants joined the final semi-structural interviews. They spoke English in their everyday work or life; therefore, we conducted all the interviews in English. The notes taken in user interviews were processed through affinity diagram technique [16]. Two researchers built the diagram together, and distilled the user insight by further brainstorming sessions.

In the next section, we report the results of log data analysis from the perspective of sessions, views, and content. We refer to the user interviews to support the analysis. These three perspectives capture user activities at different granularity levels. The analysis about sessions examined user activities at a coarse-grain level. We use 5 minutes between neighboring accessed views to break sessions. All together there were 3071 sessions. This number did not include the sessions that a user glance at the screen but did not visit any other views. The logged data did not cover the events of turning on and off the display. The analysis of content and views examined user activities in more fine-grained details. We only considered the first click of any item when computing click statistics. All together the active users visited 32551 views, and clicked 5783 (5.7%) out of 100688 items during the study.

## 5. RESULTS

Figure 3 depicts the number of social sessions on each day during the trial. For all users ( $N=20$ ),  $M=118.64$ ,  $SD=57.13$ ; for individual user,  $M=8.47$ ,  $SD=4.08$ . Overall, the users were more active (for individual user:  $M=11.46$ ,  $SD=2.67$ ) in the first two weeks than in the last two weeks (for individual user:  $M=5.18$ ,  $SD=1.82$ ).

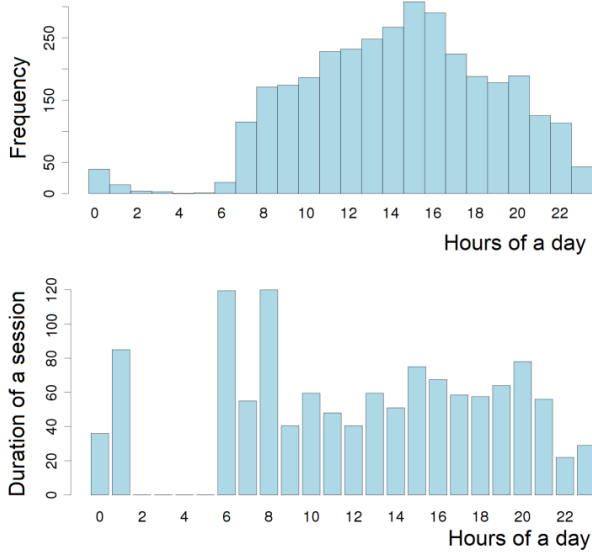


**Figure 3. Number of social sessions during the trial.**

LinkedUI became slower after accumulating data over time, which was mentioned as one main reason for the declining usage in the user interviews. The performance problem was so bad for six active users that we had to allow them to leave the study one week before the end of this study. Other reasons highlighted the unreliable implementations in call handling (e.g. up to 5 seconds delay in ringing tones, no dialer interface), text messaging (e.g. occasionally crashing when sending messages), and web browsing (e.g. no support to flash videos, high chance of crashing), lack of support to calendar, camera, and location functions, and low quality of visual designs. None of these problems were directly connected to the principle to integrate social networking services into mobile devices.

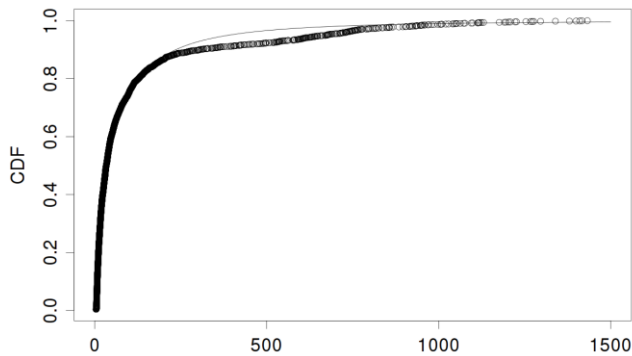
## 5.1 Sessions: Frequent Checking Activities

LinkedUI supported a constant flow of social awareness streams. We analyzed the temporal characteristics of usage sessions to explore the behavioral impact of this design.



**Figure 4. Frequency of social sessions over hours of a day (top), median of social session duration in seconds over hours of a day (bottom).**

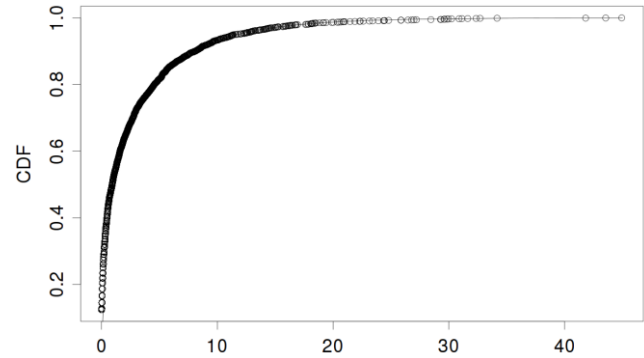
The users were active in any time of a day when they were awake as shown in Figure 4. The top chart in Figure 4 shows the frequency of mobile social sessions over different hours of a day. The usage time peaked at 3-5 PM. On a working day, some users often took coffee breaks in this time; the others were likely to be on their way home. Some Finnish workers, such as the ones having young kids, often leave office at 4 PM. The bottom chart in Figure 4 reports the median duration of all sessions in seconds. It shows that the users had similar length of sessions in a day except the ones in the morning. These morning sessions were longer than other sessions. Besides other reasons, the users might have been catching up with new content that accumulated over night. The sessions in late night between 2-5 AM happened rarely so we did not plot them in the bottom chart. Overall, these sessions were longer than other daily sessions.



**Figure 5. Breaks between mobile social sessions in minutes, empirical and fitted (solid line) CDF.**

The users checked social networking services at short intervals. Figure 5 presents the cumulative distribution function (CDF) of

breaks between neighboring mobile social sessions. The line consisting of circles is the actual sessions. The other solid line is a fitted lognormal distribution ( $\mu_{\log}=3.75$ ,  $\sigma_{\log}=1.45$ ). The median of all breaks was 33.67 minutes. In other words, 50% chance was that a user checked LinkedUI again within half an hour after each session. The average break was 115.89 minutes (SD=216.23, N=3070). This difference between median and mean was caused by the presence of long breaks, e.g., during busy working days, sleeping hours and some weekends.



**Figure 6. Duration of all mobile social sessions in minutes, empirical and fitted (solid line) CDF.**

Most sessions were brief in duration. Figure 6 shows the CDF of the durations of all mobile social sessions. A fitted gamma distribution ( $\alpha=0.378$ ,  $\beta=0.136$ ) is shown as a solid line. The median of all sessions was 0.93 minutes in duration (M=2.80, SD=4.60, N=3071). In these short sessions, the users only managed to glance at the integrated streams or carefully read one or two items. The high frequency of brief sessions suggests that users formed some habits in checking LinkedUI devices, for example, when there were short periods of time between planned activities such as waiting for a lift to come, or for a meeting to start. These breaks were typically restricted in duration, and occasionally extended to minutes. For example, one user said that he was sometimes “hooked up to check what was going on after some initial teasers”.

**Table 1. The number of items clicked in a session.**

# Items clicked in a session	#Views (mean)	Frequency	Ratio
0 items	4.6	1582	52%
1 items	7.0	575	19%
2- 5 items	14.3	591	19%
5+ items	39.4	323	10%
<b>Total</b>		<b>3071</b>	<b>100%</b>

## 5.2 Content: Selectively Clicked Items

As mentioned above, the users checked their mobile devices frequently, but they only clicked content items occasionally. Table 1 show the number of items clicked in each session. In 52% of all sessions (1582 out of 3071), they did not click any content at all. Put in term of content, on average the users only clicked 5.7% of the incoming content (5783 out of 100688 items). In the following quotation, a user (User 20) borrowed the “newspaper” metaphor to explain his low click rate. He did not read all content on the

integrated social networking services just as he would not read all articles in a newspaper.

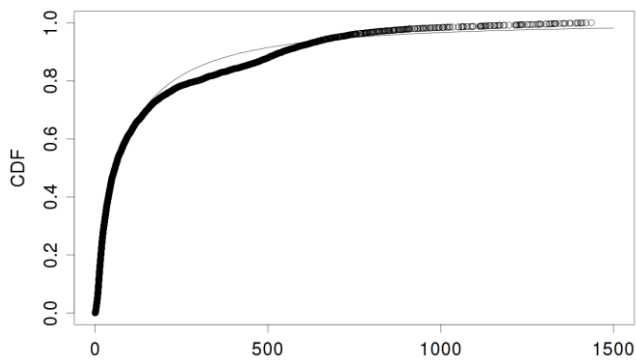
*“It is like you are reading a newspaper. You scan the headings, and start to read the parts that get your interest. You probably will never read a newspaper from beginning to the end.”* (User 20, 39 years old, male, using Facebook via N900 desktop widget and browser before this trial)

In LinkedUI, a participant can see the following information before clicking an item: the first six or so words of each content item, the contact initiating the status updates, and the contact who commented for comment items. The entire content text of an item and its conversation history was only shown in completeness after the participant clicked it. In this section, we examine the clicked items in more details. These clicked items arguably reflect what interested our participants the most.

### 5.2.1 Time

As a general observation, users tended to click the most recent items in LinkedUI. Figure 7 presents the distribution of the delays between the time an item got clicked and the time it arrived in LinkedUI. A fitted lognormal distribution ( $\mu_{\log}=4.15$ ,  $\sigma_{\log}=1.50$ ) is shown as a solid line. The median delay was 57.8 minutes ( $M=171$ ,  $SD=246$ ,  $N=5783$ ). In other words, for a clicked item, at a 50% chance the clicking action occurred within an hour.

*Facebook is just kind of media, Twitter definitely, that things just come and go. You make a conscious decision that you just let the message flowing. You don't really care about, for example, two days old things. I would never ever search for those kinds of things.”* (User 12, 43 years old, male, mobile browser user before this trial)



**Figure 7.** Delay for the clicked items, empirical and fitted (solid line) CDF.

LinkedUI helped users act upon *time-critical* content that they would have missed otherwise. Concrete examples of time-critical content include announcements of a new born baby or an incoming vacation, and messages about being in a bad mood or under the weather. Other examples include open invitations such as “9:00 pm, Bar Amsterdam, Join”, or first-come-first-served offerings. During this field trial, User 12 found and joined one bar crawling night. User 15 got gig tickets from one of his online contacts who gave the tickets away for free on Facebook.

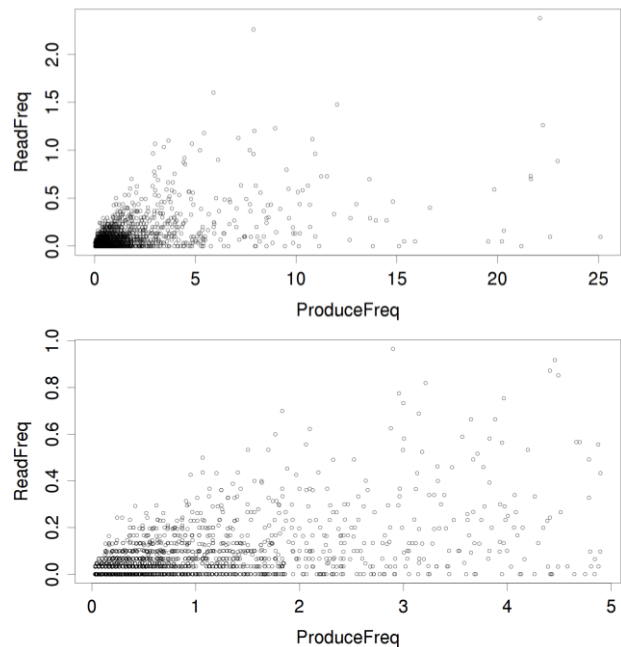
As shown in the quotation below, the user appreciated a quick access to the time-critical content as its value disappeared quickly over time. User 10 appreciated the possibility to respond to any

item the first, “When I like a post, I want to like it really fast, showing people I like it.” “Like” is a Facebook feature to advertise interest or acceptance of a topic.

*“Mobile device is good for the updates valid for a short period of time. They just come and go. For updates like ‘Hey, I am going there’, it is very good if you can catch it. It is not a big deal if you miss it, either”* (User 12, 43 years old, male, mobile browser user before this trial)

### 5.2.2 Contacts

Analysis of logged data suggests that the user followed content from a portion of his or her contacts, and ignored content from the others. Figure 8 presents a scatterplot of how the content from individual contacts was clicked. The x-axis is the average frequency that a contact published in a day. The y-axis is the average frequency that the contact’s content got clicked in a day. The chart reveals a large variance. This means that the users attended to some content depending on the contact who published it. They closely checked content from some contacts while ignored the others.



**Figure 8.** Scatterplot between producing frequency vs. read frequency in days (top); Scatterplot for the contacts who produced 5 items a day or less (bottom).

We examine the relationship of publishing and click frequency to explore if publishing frequency indicates the relevance of a contact. The users were split into 7 equal groups according to the rising publication frequency, as shown in Table 2. For the contacts who published more, their content was also clicked more often,  $F(6, 3439) = 3.73$ ,  $p < .01$ ; the click rate were highest for contacts who published at medium levels,  $F(6, 3439) = 170.73$ ,  $p < .01$ . This indicates that publishing frequency of a contact contributed to rate of the contact’s content being clicked. The users were more likely to neglect the contacts with extreme publishing frequency, either too high or too low. The group with high publishing frequency

included many internet bots that published content from news websites.

**Table 2. Relationships of click rate and publishing frequency.**

Groups	Publish	Click	Click rate
Group 1	0.04	0.00	5.69%
Group 2	0.08	0.01	7.07%
Group 3	0.17	0.02	10.53%
Group 4	0.30	0.03	8.60%
Group 5	0.55	0.04	8.06%
Group 6	1.10	0.08	7.54%
Group 7	4.70	0.24	5.26%

The user interviews reveal that that relationship closeness indicated the importance of a contact. For example, the users often closely checked their close contacts and ignored other contacts in the fringe. The relationship closeness could be inferred by mining online interaction histories. For example, some previous studies proved the feasibility to detect relationship strength on the basis of observable interaction activities such as commenting history and the number of common friends [15].

### 5.2.3 Other Factors

The users were interested in the content that directly addressed them. The examples included friend requests, direct messages, posts to their wall, and comments to their posts, and comments to the conversations that the users had contributed to earlier.

Content type was another indicator of content relevance. Content that included images and video links was perceived as more interesting than content that included texts only. Some textual content was perceived as boring or even disturbing when it was unnecessarily verbose, or when it was about daily routines such as “in meeting” and “at lunch” from super active publishers. Being people focused, LinkedUI does not show automated content produced by Facebook applications. All users spontaneously praised the design principle in hiding applications because some applications, for example games, tend to publish too much.

## 5.3 Views: Diverse Access to Integrated Social Networking Services

LinkedUI combined content from multiple services and used hypertext navigation to organize all the content and functions of the entire device. It can present content in any view that is logical to users, for example, the activity stream view, the home view, the item view, the contact view, and the search view. Table 3 presents how often the users clicked content from these views. This table also includes views, where the user clicked on items he or she had clicked before, thus the slightly higher total number than the clicks reported in section 4.3 (6454 vs. 5783).

The *activity stream* view presents the entire social awareness stream in reverse chronological order. See Figure 2. Most of the content (72.68%) was accessed through this view. It provides tabs for users to check individual services. Three users actively visited these service tabs, all other users typically stayed in the default tab that presented content from all aggregated services. Our design treated comments as individual items, and only threaded them into

conversations in item views. Most users argued for a full conversation structure in this view.

The *home view* shows the three latest social networking content items dominantly (cf Figure 1). 22.90% of the items were clicked from this view. The users liked this home view integration as they “can see things right away instead of having to click many times to get them”. The easy increase increased the chance bumping to content from social networking services. The users might just glance at the device, and follow whatever relevant things in the flow, as User 17 said below.

*“<before this study> when I was using Facebook, I needed intentionally to open Facebook application, and I needed to WANT to find out what happened there. LinkedUI brings me some Facebook updates even when I am just using a phone. That is a good thing. If the information is something I do want, it is very easy to see it, and actually it is hard to miss it. Then you easily get interested and start browsing most probably. I feel I am better connected to my friends as I am better aware what they are doing.”* (User 17, 30 years old, male, using Facebook mobile apps before this trial)

**Table 3. Views from which items were clicked.**

Views	Frequency	Ratio
Activity stream	4691	72.68%
Home view	1478	22.90%
Item view	170	2.63%
Contact view	113	1.75%
Search view	2	0.03%
<b>Total</b>	<b>6454</b>	<b>100%</b>

The *contact view* presents all content from a single contact in the same view. LinkedUI automatically links identities with identical names, and helps users to manually link others. The users only occasionally (1.75%) used the contact view to check social networking content overall. In the user interviews, all reported that they rarely used it other than special occasions, for example, user 4 used it to check on her father who seldom published something. Four users reported that they came across what their contacts published on social networking services when trying to make or receive phone calls. One user started a conversation on what he read when talking to a business contact. Another user referred to impress his wife in a phone call by refereeing to what she published on Facebook, as in the quotation below.

*“One thing I really like, I thought that is delightful feature. You see the latest updates of a person when he is calling. I really like it, especially when my wife is calling. She would ask me, did you like my status update on Facebook? I could say, no, but I read it.”* (User 1, 33 years, old, male, using Twitter via a mobile application)

The *search view* was primarily used to locate a contact for calling and messaging, and seldom (0.03%) used to locate a social networking content item. In the user interviews, about half of all users appreciated the inclusion of content items in search results because they perceived the content interesting, and sometimes useful, as quoted below.

*“It is good to show such content in the results when I search for a person. You may bump into something interesting.”* (User 9, 38 years old, male, Android application user before this trial)

In the above-mentioned views, LinkedUI combined content from multiple services in content presentation. These views showed the integrated social networking services together with access to other content and applications. Nearly all users appreciated this design principle as it reduced the steps to access content. These designs also promoted less-often used services. As quoted below, the user simultaneously saw these events when checking their main services. She would not have bothered checking these less-often used services if these services were kept as separate applications. In short, LinkedUI supported “*serendipitous content discovery*”, or the users encountered with social networking services when performing other mobile tasks [5, 18].

*“I have enjoyed using Flickr in LinkedUI. It is a service that I usually only access from the computer and admittedly do that quite seldom. I have browsed more photos from Flickr now that it is available easily via LinkedUI.”* (User 4, 32 years old, female, mobile browser user before this trial)

## 6. DISCUSSION

On social networking services, people share small pieces of information with their articulated social networks or with the public [8]. These information pieces do not require any response, but provide an overview of what had happened and to whom [22]. With the integrated social networking services such as in LinkedUI, people can follow the content from multiple services with minimal effort on mobile devices. Similar to the early studies about *awareness* [e.g. 7, 12, 13], these people are able to effortlessly follow who is “around”, which activities are occurring, and who is communicating with whom. All content is readily available for them to glance at, interact with, or act upon, in the same way as other composite web services [30].

The frequent and brief sessions in LinkedUI indicate that people form habits of checking their mobile devices at intervals [24]. Even without specific goals in their mind, people still frequently check the integrated social networking services and follow the dynamic content. The analysis on diverse view access indicates that people sometimes spontaneously browse content when checking other active social networking services or when performing other mobile tasks such as handling phone calls.

### 6.1 Habitual Checking

LinkedUI was used in frequent short spurts of activities. These sessions occurred more frequently than with stationary computer users [3]. Each session lasted for a short time, shorter than their computer counterparts [3, 27], and other mobile web tasks [11]. These short and frequent sessions were triggered by a quick access to dynamic social networking services as reward. All these characteristics suggest that most of these activities were parts of *checking habits* that emerged in user practice with mobile devices. As reported in a recent publication, “checking habits are automated behaviors where the device is quickly opened to check the standby screen or information content in a specific application” [24]. In LinkedUI, people briefly and repetitively inspect the dynamic content due to the effortless access from the integrated social networking services.

The habitual checking dominated the LinkedUI usage. None of our users, however, complained that their frequent usage of the integrated services was a forced addiction. Some of them cited the popular push email as a key reference to explain their easiness with frequently checking LinkedUI. Compared with pushed email, “these messages were actually funnier to read”. As shown in the following quotation, one user (U18) even praised the service integration for relieving his stress.

*“The design was ‘stress relieving’. <With LinkedUI>, I did not have to go to some website to pull the data all the time. Instead, I just needed to check them out here and then leave it.”* (User 19, 19 years old, male, N900 desktop widget and web browser to use Facebook before the trial)

In short, with integrated social networking services from mobile devices, the users started to habitually check the devices at high frequency, but overall, none of the users reported these new habits as problematic. This result was similar to early study with checking habits on mobile devices. “Users themselves do not necessarily describe habit formation as problematic. Even when the phone usage is dominated by frequent checking, people described the use as, at worst, slightly annoying.” [24] This conclusion needs to be studied further, considering the limitation of this study, such as small size, short duration, and users from technology savvy groups.

### 6.2 Serendipitous Content Discovery

LinkedUI combines content from multiple services, and structures the entire user interface by hypertext navigation, which makes it possible to present social awareness stream in any view. We experiment with five views: the home view, the stream activity view, the contact view, the search view, and the item view.

Based on the logged data, we found that the users primarily relied on the activity stream view and the home view to access content, and that other views including the contact view were occasionally used. Based on the user interviews, we found that showing content in diverse views supports the use case of serendipitous content discovery. The users came across content from less often used services when checking regular services in the home view and the activity stream view. They also enjoyed bumping into some content when handling phone calls from the home view, the contact view, the search view or the call handling dialogue.

Serendipitous content discovery emerged in our log analysis and user interviews as a common use case, although we still need further evidences to substantiate this claim. To facilitate this use case, the future studies may consider presenting the integrated services in more views such as calendar view, map view, and camera view, and to quantify the popularity of this use case. The future research should explore the related design principles. For example, should we focus on the content relevant to the current view, or the content relevant to the user regardless of the view? Should we focus on the content similar to early user interest, or the different parts? What is the right occasion to trigger user to browse? How we should avoid distracting users who try to accomplish an urgent goal in a hurry?

### 6.3 Access to Relevant Content

The users only attended to a small portion of important content from mobile devices. Overall, users only clicked 5.7% of all received content, for example, recent content, and content related

to the users or their most important contacts. This result supports some recent user interview studies that argue mobile devices should support focused consuming [25].

LinkedUI limits the content to the first six words of the content, which requires the participants to click the item if they want to fully understand the content. We argue that the low click rate reflects the fact that the users only attended to a small portion of content. For some messages, the users could attend to them without clicking actions because the first six words could give enough information. For majority of messages, however, we believe that the users still needed to click for details. At least, the users had to click an item to see the conversation history where the post or the comment was a part of, or to respond to an item.

One plausible explanation of the low click rate was associated with information overload [17]. The users received overwhelming amount of new content so that they dismissed the majority of it. A hint of this is that the participants checked the most recent items, dismissing the others when busy with other things. In the user interviews, many users complained about the difficulty to locate the relevant elements from the full content set. The following quotation highlights the user frustration to find relevant content.

*"I am overwhelmed by the number of messages. As a result, I do miss the updates I want to comment. I cannot easily see the updates from my close friends"* (User 18, 31years old, male, mobile application user before this trial)

As a design implication, the system should guide the users to the most relevant content. For example, a recommendation system may identify and highlight the important content in the user interface, such as the home view and the activity stream view. As we learned from user behavior, such system should highlight the recent content. It should focus on presenting new content that arrives after the user's last check. The system should also explore the relationship closeness to highlight content from the relevant contacts and de-emphasize others.

The quick access to relevant content could facilitate the practices of using integrated social networking services on mobile devices. With more relevant content highlighted, the users potentially need less time in habitually checking their mobile devices while remaining aware of the key events; they also get higher chance to come across content of relevance from the views with integrated social networking services.

## 6.4 Research Limitations

The findings in this paper can potentially be generalized for other mobile social networking applications and services. Here we list some key limitations for this generalization.

The specific LinkedUI designs may limit generalizing the findings to other systems. Other systems may not support the same views and the hypertext navigation to connect the views as shown in Figure 1. Both the home view and the activity stream view list social awareness streams in reverse chronological order. This may make users to click the latest content more often than otherwise. In LinkedUI, the users cannot read an item in full details before clicking it. This may further highlight the importance of contacts. The hypertext navigation enabled to present content in any views of the device, which may not be possible with other tools.

LinkedUI supported Facebook, Twitter, and Flickr, which do not represent all kinds of social networking services such as social location services. Some other common smart phone functions, such as calendar and business email, were not available. The users might have used the device more often otherwise.

The study was a medium-length field study of four weeks. The users might use social networking services differently after the novelty vanishes. It was a closed trial. We did not release the application for a public trial, but gave a pre-configured device to a small number of users for test. All users were working in the same large international corporation due to data logging limitations. Due to these limitations in test settings, the findings from this study need further confirmation with larger scale user studies.

## 7. CONCLUSION

In this paper, we explored the user behavior of social networking via a mobile social network aggregator. The research method was a 4-week field study using LinkedUI. This study suggests that a social network aggregator enables people to be aware of their online social networks. The key findings are:

- Habitual checking is the most common use case where people habitually glance at the social networking content at intervals in short micro-breaks. The integration of social networking services enabled people to be aware of their social networks with minimal attention.
- LinkedUI supports the integration of social networking services in any view that is logical for users. These diverse views increase chance encounters with relevant content. The users enjoy the possibility to occasionally read content when performing other tasks.
- The users only clicked a small portion of content. Common examples include just-published content, and content from selected contacts. This suggests that future designs should provide quick access to the relevant content.

More user studies are needed to further confirm these findings, and explore new designs. In the next step, we are planning to run a large-scale open trial with LinkedUI or with other aggregators. The trial should cover other types of social networking services such as social location services and social music services. The other future plan is to address information relevance problem in integrated social networking services. We shall implement automatically personalized recommenders, and evaluate the alternative systems through field trials.

This study focuses on online user activities, assuming that one could be better connected with others when the person is aware of what the others are doing online. This assumption is supported by some existing studies. For example, prompt awareness of some content has potential to trigger more social interactions [14, 29]. University students may use these services to organize ad-hoc gatherings [2]. Based on these studies, we believe that integration of social network services to mobile devices can help people in bridging, maintaining and bonding relationships. To fully understand social impacts of these systems, we should conduct user studies that cover both online and offline activities in order to reveal the effects these systems may introduce to our lives.

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