Chapter 16
Design and Evaluation of Intentionally Enriched Awareness

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Abstract In this chapter we introduce and explore the notion of "intentionally enriched awareness". Intentional enrichment refers to the process of actively engaging users in the awareness process by enabling them to express intentions. We initially look at the phenomenon if sharing intentional information in related collaborative systems. We then explore the concept of intentional enrichment through designing and evaluating the AnyBiff system which allows users to freely create, share and use a variety of biff applications. Biffs are simple representation of predefined activities. Users can select biffs to indicate that they are engaged in an activity. We summarise the results of a trial which allowed us to gain insights into the potential of the AnyBiff prototype and the underlying biff concept to implement intentionally enriched awareness. Our findings show that intentional disclosure mechanisms in the form of biffs were successfully used in a variety of contexts. Users actively engaged in the design of a large variety of biffs and explored many different uses of the concept. The study revealed a whole host of issues with regard to intentionally enriched awareness which give valuable insight into the conception and design of future applications in this area.

16.1 Introduction

Awareness concepts in HCI increasingly utilise the notion of *context awareness*. The move towards context emphasises the need for a richer set of awareness information that goes beyond the traditional 5 W-questions[1] which are a defining characteristic of early awareness mechanisms. A number of systems have implemented context representation, notably *placeless documents* (Dourish et al. 1999) and *event*

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[1] Where, when, who, what and how.

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notification infrastructure (Prinz and Gross 2004). Additional contextual information can lead to a richer description of activities and situations in awareness systems. However, additional information also poses additional challenges and questions for the design of awareness mechanisms. How can we gather additional information that will help users to contextualise their actions? How can additional information reflect people's intentions and context? How can additional information help receivers to effectively select information that is relevant to them?

In this chapter we will introduce and explore the notion of "intentionally enriched awareness". Intentionally enriched awareness is based on the idea of enabling users to be actively involved in the process of providing awareness information. If users are enabled to provide additional contextual information they can add meaning to seemingly disjoint activities. For instance, people generally know why they are editing documents, in which work context particular changes are made, whether the edits are rushed or thorough and so on. However, few awareness mechanisms allow users to leverage this knowledge as part of the awareness process. Practically, intentional enrichment of information could be achieved by a variety of means ranging from annotation, through setting status messages that indicate activities, to the selection of pre-defined or dynamically evolving context descriptions. The objective of the model of intentionally enriched awareness that we discuss here is to provide a structured approach to think about how this information can be harnessed and integrated into the awareness process.

For the following discussion we will employ a simple actor−receiver model that is common for many event-based awareness mechanisms (Lövstrand, 1991; Fuchs et al., 1996). The actor is the source of the awareness information while the receiver is the person potentially interested in some of the information.[2] We refer to the process of actors providing information about their intentions, circumstances and context as "intentional disclosure". One of the main challenges posed by this approach is that being involved in the process of gathering awareness information creates additional workload for actors, potentially leading to a disparity between work and benefit (Grudin, 1994). However, there are many examples of intentional enrichment outside awareness systems. For instance, annotating changes in a word document, aggregating and individualising information in blogs, tagging URLs and media with freely defined categories in social bookmarking services like del.icio.us[3] and photo sharing sites like flickr,[4] setting the status information on an instant messaging client to define availability or location, and so on. All of these activities require a certain effort, yet people constantly engage in them because the perceived benefit at least equals the workload. The challenge for designing intentionally enriched awareness

[2] A number of terminologies have been suggested to describe the roles of actors and perceivers, e.g. sender–receiver, actor–observer, informer–informant all of which define the balance between the two roles in slightly different ways. We will continue to use the terms 'actor' and 'perceiver' for the remainder of this chapter.

[3] http://del.icio.us

[4] http://flickr.com

systems is to provide awareness tools that enable the enrichment of information, yet reduce the effort that is required in doing so.

While mechanisms that allow actors to contribute contextual information exist, very few are integral parts of awareness systems. We have previously proposed a framework (Atmosphere) that enables intentionally enriched context awareness and provides mechanisms on different scales of effort (Rittenbruch, 2002). In this chapter we will define a model of intentionally enriched awareness that is based on the Atmosphere model. We will furthermore describe the design, implementation and evaluation of the AnyBiff system which implements one particular aspect of intentional awareness. AnyBiff is a generic activity announcement tool that lets users share intentions to engage in activities and social context with relative ease. The concept extends the notions which were implemented in the CoffeeBiff application which originated at the Distributed Systems Technology Centre (DSTC) (Fitzpatrick et al., 1999).

16.1.1 Chapter Structure

We will explore the concept of intentionally enriched awareness from a number of angles. Initially we will look at existing awareness research and motivate intentional enrichment as a necessary enhancement to existing awareness concepts (Section 16.2.1). Following this we will define the notion of intentionally enriched awareness (Section 16.2.3) which is based on our earlier work in this area (Rittenbruch, 2002). We will then briefly summarise common practices of intentional disclosure in a number of different areas (Section 16.3). Following this we will summarise findings from a previous implementation and evaluation of an intentionally enriched awareness service (Rittenbruch et al., 2007). The AnyBiff system is a generic implementation of the biff concept described by Fitzpatrick et al. (1999) allowing users to freely create, share and use a variety of activity and status indicators. The field trial and evaluation of AnyBiff provide valuable insights into the design of intentionally enriched awareness services as well as the applicability of the underlying model. We will reflect on those findings and discuss design implications.

16.2 Intentionally Enriched Awareness

16.2.1 Motivation

The necessity for intentionally enriched awareness is motivated by two arguments. The first argument analyses the role of intentional activities by looking at the roles of actors in existing awareness models. The second argument is based on Heath et al.'s observation that actors in distributed work settings deliberately try to gain the attention of their colleagues and skillfully gauge the level of obtrusiveness needed to do so (Heath et al., 2002), and Schmidt's critique of passive awareness which builds on these results (Schmidt, 2002).

16.2.2 The Passive Actor

When Fuchs et al. introduced their event distribution model in 1996, awareness models were considerably simpler than today (Fuchs et al., 1996). The model introduced an actor and a perceiver[5] connected by an event pipeline.[6] Events based on the actor's actions were automatically gathered and sent to a database, called the event-history. The receiver would access the database to gain access to the event information that he was interested in. There were several filters that allowed the flow of information to be restricted. On the actor's side there was an individual privacy filter that allowed actors to set privacy policies for the events gathered about them. A global filter would allow for the filtering of general conditions, e.g. in order to comply with organisational policies. On the perceiver's side an individual interest filter allowed the perceivers to subscribe only to those events they were interested in. Despite its simplicity the pipeline model remains a valid approach that describes the underlying mechanism of many event-based awareness services.

What is striking is that the role of the actor is one of the few aspects that have not been addressed in more detail over the years. While the receiver has an increasing amount of control over which awareness information is received and how it is received, the actor does not contribute additional information other than being the target of an automated gathering process. This is even more surprising in the light of the fact that the actor has detailed knowledge about the activities he performs, including information about his intentions and the context within which activities take place; information that is either hard or impossible to deduce from automatically gathered events.

Our notion of awareness introduces the possibility that the actor can choose to externalise internal processes (intentions, reasons, etc.) and inform others of actions which cannot be directly sensed by the computer. We do not want to be misunderstood as criticising event-based awareness concepts per se. The gathering and distribution of awareness events is a necessary requirement for any awareness service that does not rely solely on a direct audio or video connection. Our emphasis lies on enrichment. Intentional enrichment does not replace awareness information. It allows internal motives to become part of the information gathered by an awareness system.

16.2.2.1 Awareness and Deliberation

The next question to consider is whether intentional enrichment can be part of the process of how co-workers become aware of each other or whether it is simply a form of communication. The latter position is being emphasised by the notion of

[5] A number of terminologies have been suggested to describe the role of the actor and perceiver, e.g. sender–receiver, actor–observer, informer–informant all of them defining the balance between the two roles in slightly different ways. We will continue to use the terms 'actor' and 'perceiver' for the remainder of this chapter.

[6] Implemented by a notification service.

"passive awareness" (Dourish and Bly, 1992). Dourish later defined awareness as being a passive process: "The passive nature of information is important. Information arises directly out of each person's activity, rather than having to be managed explicitly" (1997). Schmidt critiques this notion of awareness as being too restrictive in order to understand the complex interaction between actors in awareness processes:

> But the notion of 'passive awareness' (. . .) is problematic in its own right, in that it mystifies what we need to understand: the practices through which actors align and integrate their distributed but interdependent activities. As if an actor's passive awareness of the state of the cooperative effort is the inscrutable effect of merely "being there" the result of some kind of osmosis. . . (Schmidt, 2002).

Schmidt continues with an analysis of Heath and Luff's work on awareness in collaborative workplace settings (Heath and Luff, 1991; Heath et al., 2002). He explores the notion that actors deliberately direct the attention of their colleagues in order to coordinate activities or emphasise aspects of their work. In doing so actors often choose a level of obtrusiveness that is appropriate to the situation (Schmidt, 2002). This skilled behaviour is in stark contrast to an understanding of awareness that does not include the active participation of actors. By acknowledging these work routines Schmidt extends the notion of awareness:

> (. . .) because of the fine-grained repertoire of modalities of monitoring and displaying, ranging from sometimes quite inconspicuous to something dramatically obtrusive, no clear distinction exists between, on the one hand, the coordinative practices of monitoring and displaying, normally referred to under the labels of 'mutual awareness' and 'peripheral awareness', and, on the other hand, the practices of directing attention or interfering for other purposes. In fact, by somehow displaying his or her actions, the actor is always, in some way and to some degree, intending some effect on the activities of colleagues. The distinction is not categorical but merely one of degrees and modes of obtrusiveness (Schmidt, 2002).

Schmidt's argument further supports the notion the actor can fulfil an active role in an awareness process.

16.2.3 A Model of Intentionally Enriched Awareness

We have argued that intentionally disclosed information can be an invaluable resource for facilitating awareness between users. A number of questions remain: Which techniques can be used to facilitate the process of intentional disclosure? What type of information can be supported? and How can the effort involved in this process be reduced? We will seek to answer these questions by describing a model of intentionally enriched awareness which incorporates different concepts to facilitate information disclosure.

We will initially take a look at the Atmosphere model (Rittenbruch, 2002), which is one of the foundations of our current model. We will then reflect on the relationship between disclosure and effort and introduce different disclosure mechanisms.

16.2.3.1 Atmosphere

The model of intentionally enriched awareness is conceptually based on our earlier work on contextual awareness (Rittenbruch, 2002). The Atmosphere framework was concerned with representing a richer set of context information, centred around the questions "Why has this happened?" and "In which context did this happen?". The framework introduced two classes of interaction techniques which allowed actors to provide contextual information with different levels of effort. "Active methods" allowed for a direct provision of contextual information, while "structural methods" used shared representations of context to allow users to assign work activities to contexts. These methods were implemented using two concepts "contextors" and "spheres". Contextors were pre-defined shared representations of user actions. Users would indicate certain activities by selecting the appropriate set of contextors. Spheres were a hierarchical representation of a particular working context. Similar to shared workspaces, documents could be associated with particular spheres. Spheres also contained sets of contextors to represent actions within a particular context. The sphere concepts comprised a variety of more detailed concepts, including a differentiation between private and group spheres, different type of sphere trees, as well as concepts to represent relationships between spheres.

Several of these concepts are used in a modified form in our model of intentionally enriched awareness. The AnyBiff prototype described in the context of this chapter can be seen as an implementation of the contextor concept. A simplified version of spheres is used to model indirect disclosure (see Section16.2.3.3). While the Atmosphere work was focused on the conceptual representation of context information in awareness models, the model of intentionally enriched awareness takes a broader look at the issues underlying intentional disclosure of information.

16.2.3.2 Effort and Disclosure

We have previously introduced a model that links the effort of disclosing information to the richness of the disclosed information (Rittenbruch et al., 2007). A high level of detail, e.g. the detailed description of an activity, in general requires a high level of communicational effort on behalf of the actor. An activity like ticking a box in a shared spreadsheet in comparison requires considerable less effort but at the same time is likely to be more constrained in its meaning.

The act of disclosing information can be represented on a scale of involvement and effort. On the low end on the scale the actor is not involved at all. No information is disclosed, but the actor's actions within collaborative systems are automatically represented as events (see Fig. 16.1, no disclosure). This approach is commonly found in event-based awareness systems, like AREA (Fuchs 1999). On the high end of the scale the actor is very involved in the process of expressing intentions, for instance being engaged in a direct communicational act with a perceiver explaining a certain activity (see Fig. 16.1, explanation). While the actor is able to portray a high level of intentional detail, the communicational effort to do so is likely to be very high and no support to reduce this effort is offered. Explanatory activities

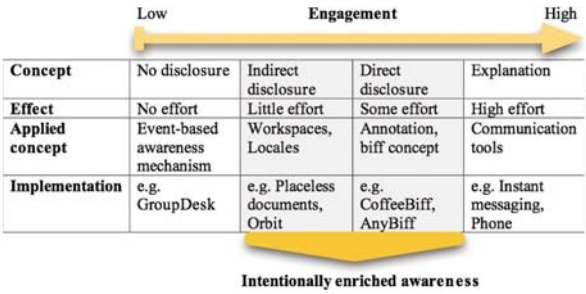

Fig. 16.1 Intentionally enriched awareness

commonly require the actor to use additional tools like e-mail to communicate intentions. Intentionally enriched awareness is situated between those two extremes (see Fig. 16.1).

16.2.3.3 Disclosure Mechanisms

In order to support actors to express contextual information we introduce two basic concepts, *direct disclosure* and *indirect disclosure*. Direct disclosure requires an immediate action by an actor in order to disclose information. Indirect disclosure allows actors to indicate the general context of their work rather than an immediate action. The following figure shoes how direct and indirect disclosure are situated on a scale of effort.

Direct disclosure is implemented by providing pre-defined indicators which allow users to indicate imminent or current activities (Rittenbruch, 2002) (see Fig. 16.1, direct disclosure). Direct disclosure is characterised by three main aspects. First, it requires immediate user action in order to disclose information. Unlike indirect disclosure where intentions can be inferred from a given context, direct disclosure is an immediate act through which users express their intentions to other users. Second, direct disclosure is characterised by a low level of communicative effort. Disclosing information should only involve a small number of interactions, like clicking a button or selecting a menu item. Thus, the concept differs from explanations which require a significant communicative effort. Third and finally, direct disclosure mechanisms need to account for a large variety of information that users need to express. They therefore need to be highly flexible and tailorable.

Indirect disclosure in comparison does not require an immediate action on behalf of the actor to indicate a particular activity. We previously discussed the aspect of relating an activity to a particular context as part of the Atmosphere framework (see Fig. 16.1, indirect disclosure). Indirect disclosure allows actors to pre-define and arrange commonly used contexts. Information can be disclosed with relatively low effort by choosing the appropriate context representations for streams of activities (Rittenbruch, 2002). For example, the Orbit system (Mansfield et al., 1997a) and "placeless documents" (Dourish et al., 1999) both partially implement this aspect of awareness.

16.3 Related Work

In this section we will look at a number of examples of systems which allow for intentional disclosure of information. We will look at two sets of systems. The first set of systems and practices is based on the explicit disclosure of information and is closely related to the concept of direct disclosure. Within this set we discuss four groups of systems: First, we will explore how instant messaging clients and related systems can be used to share personal information, including information about current activities. Second, we will briefly touch upon creating awareness through posting messages to ambient displays. Third, we will look at the practice of "today" messages and systems that build on that notion. And last, we will look at concepts that are very similar to the AnyBiff system which we implement here, including other implementations of biffs and an affective computing interface which shares emotional state.

The second set of systems which represents aspects of a user's context are more relevant for the concept of indirect disclosure. We will look at the practice of tagging and systems that implement shared workspaces in this context.

16.3.1 Sharing Status

The potential of instant messaging to support informal interaction and awareness is becoming increasingly well understood (Nardi et al., 2000; Herbsleb et al., 2002; Isaacs et al., 2002; Voida et al., 2002). Instant messaging clients support awareness about the presence and availability through "buddy lists" (Rittenbruch and McEwan, 2008, in this book). An increasing number of instant messaging clients also provide the option to show status messages to other users. Status messages can either be pre-defined messages concerned with availability (e.g. available, busy, away)[7] or custom status messages[8] which allow users to define messages freely.

Status messages have become a focus of research as they allow users to relay awareness information which extend the original focus on availability. Smale and Greenberg (2005) have investigated how instant messaging clients are used to broadcast personal information to other members of a group. Their initial study showed how people used "display name" fields as makeshift status messages as the client used in their study did not support custom status messages. They identified a rich set of communication practices used to communicate different aspects of a person's work or personal context to others. The main use of status messages was to indicate current activities, emotional state, location and personal comments and opinions. The study also revealed that status messages were occasionally used to broadcast information to the group.

[7] Found in the original version of ICQ (http://www.icq.com).

[8] Example, in Apple iChat (http://www.apple.com/macosx/features/ichat/).

Another related system that is used to share activities with peers is Twitter. [9] Twitter asks a single question, "What are you doing today?". The information that people provide is forwarded to the list of peers who have subscribed to the feed that a person creates, usually via SMS messages. While currently no research exists on this system it makes an excellent example for how status messages can be used outside IM clients.

16.3.2 Displaying Messages

A number of authors have explored the effects of displaying freeform messages on ambient displays to create awareness (e.g. Greenberg and Rounding, 2001; Dey and De Guzman, 2006; Cheverst et al., 2007). This idea has recently gained traction in the context of domestic environments (e.g. Saslis-Lagoudakis et al., 2006). While the particular mode of notification has no immediate impact on our notion of intentional enrichment we are interested in the question how users are encouraged to create messages. The ASTRA system (Romero et al., 2007) is interesting in this context as it encouraged the use of the system through a ToTell list, a set of items that would trigger social and emotional communication.

16.3.3 Today Messages

Brush and Borning (2005) reported on the use of "today" messages in their lab. Group members would send daily free form e-mails titled "today" to their work group outlining activities and any other information they choose to disclose. The practice originated within a group of software engineers who used "today" messages as part of their software development process. The authors of the study hypothesised that this simple process can lead to a low conceptual load for users in comparison to more involved formal reporting. The use of "today" messages by six different groups was studied. The results show that most users perceive the effort involved in reading and writing "today" messages as low; however, some users would perceive the lack of a format as unproductive. The content of "today" messages varied between individuals and groups. Some groups included critique into their messages, while other groups included more personal information. The authors found that a determining factor for the success of "today messages" is the participation rate of group leaders. The authors suggested a couple of technical implications. First, subscriptions should be flexible and not bound to a mailing list so users can subscribe to those today messages they are interested in. Second, "today" messages should promote reciprocity; users should be able to determine who is reading their messages.

[9] http://twitter.com; There are a number of systems that provide similar functionality, e.g. Jaiku (http://www.jaiku.com) or facebook status updates (http://www.facebook.com).

The idea of "today" messages has been applied in Smale and Greenberg's "Transient Life" system (Smale and Greenberg, 2006). Transient Life is a sidebar which supports users in gathering transient information on the fly. The information gets collected and is sent out in the form of a "today" message by user request. The type of information gathered by Transient Life includes, lists of activities, to-do's, emotional status and photos.

16.3.4 Single-Click Sharing

Single-click interfaces like CoffeeBiff (Fitzpatrick et al., 1999) are closely related to the concept of direct disclosure. We will briefly look at the development of the biff concept in context.

16.3.4.1 A History of Biff

In October 1980 BSD 4.0, a Unix variant was released to the world. It included a tiny command line program called "biff" named after a dog owned by one of the students, Heidi Stettner (Salus, 1994). The program monitored the user's mailbox and, when mail arrived, either wrote a message to the terminal or simply rang the terminal bell to notify the user.

In February 1986 the X Window System, a graphical windowing system developed at MIT was released including a small graphical program called "xbiff" which duplicated biff's essential function but graphically using a small image of an American-style mailbox to notify the user (see Fig. 16.2, left picture).

In May 1997 Elvin, a distributed notification system developed at DSTC Pty Ltd was released (Segall and Arnold, 1997). One of the first client programs for Elvin was "xebiff" which used the Elvin infrastructure to monitor the user's mailbox. A student working with the Elvin project was very fond of a multi-player videogame called "xpilot" and was always keen to find partners to play with. He adapted the xebiff program to make "xpilotbiff" – using the xpilot icon in place of the mailbox.

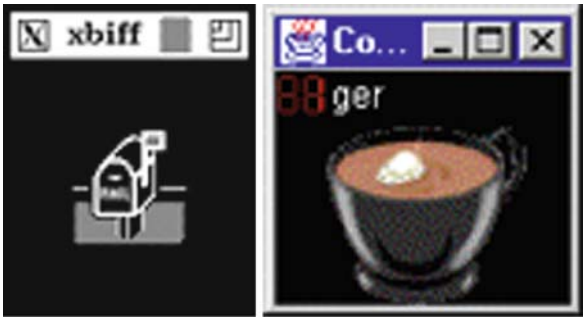

Fig. 16.2 The xbiff and CoffeeBiff interface

Players signalled their desire to start a game by clicking on their icon, which caused all the other potential players' icons to change state, signalling that someone was in the game and ready to play.

Shortly after that, a second simple adaptation was developed to signal intent to visit the coffee room. This program, "xcoffeebiff" , incorporated several novel features. By clicking on the program's coffee cup icon, all users' corresponding icons changed state, displayed a scrolling username display showing the names of everyone who had clicked and incremented a counter so users could see at a glance how many people were heading for coffee (Fitzpatrick et al., 1999). Figure 16.2 (right picture) shows a screenshot of CoffeeBiff, a version of xcoffeebiff running on PCs. The biff has been activated by one user. The name of the user who activated the biff, "Geraldine", is scrolling across the username display.

This sequence of related tools introduces concepts that are each important to AnyBiff. First, the notion of a simple indicator of a state change, unobtrusively within the user's field of view. Second, the notions of tying the simple notifier to an agreed action or state and indicating intent to participate by clicking. Third, augmenting the simple display to indicate which people have signalled their intent.

16.3.5 Sharing of Structure

The second approach is based on the implicit sharing of intentional information. Artefacts are arranged and categorised through hierarchical or non-hierarchical structures which link them to a particular work or personal context. We will look at shared workspaces and the practice of tagging in this context.

16.3.5.1 Shared Workspaces

The shared workspace metaphor has been a common metaphor for the design of groupware systems for around 15 years. The term is used widely ranging from concepts that imitate shared physical workspaces (Ishii, 1990; Ishii and Arita, 1991), over shared media spaces (Bly et al., 1993), to shared data repositories that contain additional functionality to support collaboration. A number of systems that support awareness incorporate the latter notion of shared workspaces, e.g. DIVA (Sohlenkamp and Chwelos, 1994), GroupDesk (Fuchs et al. 1995), BSCW (Bentley et al., 1995), TeamRooms (Roseman and Greenberg, 1996) and Orbit (Mansfield et al., 1997b) to name just a few (see Rittenbruch and McEwan, 2008 for a comprehensive summary).

We are interested in shared workspaces as a means to structure information and share this structure with other users. Shared workspaces also go beyond just sharing information by typically providing congruent views of that information to all participants to enable them to share a common context.

Orbit (Mansfield et al., 1997b) teased apart these two ideas using the "Site and Means" and "Individual View" concepts from Fitzpatrick's (2003) Locales Framework. Orbit provided shared collections of data called "zones" that provide a shared

space in which collaboration can occur but allowed multiple shared "views" into those zones. By using the same view on a zone participants could maintain congruent views when needed and shift to different views to support a different level of involvement and interest. Orbit allowed participants to have views into multiple zones at the same time.

16.3.5.2 Tagging

Tagging (Marlow et al., 2006) is a very different approach to contextualise information. It describes the practice of attaching keywords to postings of photos[10] or other content and URLs. Tags are freely formed and do not adhere to pre-defined categories. Tags allow users to discover related posts or content that has been identified by the same keyword(s). Thus tags form a loosely structured, user-defined categorisation space often referred to as folksonomy. The process of tagging does not necessarily need to be undertaken with the explicit intention of sharing content or categories. Golder and Huberman (2006) found that a considerable amount of tagging on the social bookmarking site del.icio.us is done for personal use. However, they point out that due to the fact that sharing sites which use tags are generally public, other users can browse content and tags and receive "recommendations" even if they were unintentional.

16.3.5.3 Disclosure in Social Networking

A whole range of other disclosure practices, which are centred around the notion of social software, aim at the disclosure of personal information to peers in social networks. This includes the disclosure of personal information in profiles (Boyd and Heer, 2006), the public articulation of self (or "fake-self") on social networking sites (Boyd, 2004) and the public disclosure of social networks (Donath and Boyd, 2004). While these practices are interesting they focus more on the creation of social network than the support for group collaboration and are beyond the scope of this chapter.

16.3.6 Discussion

How are these approaches related to intentionally enriched awareness? We will look at three groups of systems that relate to direct disclosure (sharing status, "today" messages and single click sharing) and one group of systems that relate to indirect disclosure.

16.3.6.1 Systems Related to Direct Disclosure

Systems that share status are a good example for how intentionally disclosed information is used to create a sense of awareness. However, the system we described

[10] Example, flickr (http://www.flickr.com).

differs from biffs in a number of important aspects. First, IM status messages, Twitter and systems that allow users to post messages to ambient displays provide information in a relatively unstructured manner. While this allows for flexibility and creativity which is desirable for informal awareness it also creates ambiguity and requires additional effort. In comparison biff interfaces are limited to a particular type of information (e.g. "drinking coffee") but are very unambiguous and require minimal effort to express an intention. In addition there is an important difference concerning the user interface metaphor behind IM clients and biffs. IM clients are user-centric, while biffs are activity-centric. The focus on a particular activity allows users to determine very quickly how many people are engaged an activity (e.g. 10 people are having coffee). To extract the same information from differing IM status messages will in general be a more involved and time-consuming activity.

The structure of today messages relies on conventions between users although templates could be used for a more structured approach. While today messages allow users to express a rich set of information it is time-consuming when compared to the simple indication of an activity in a biff. On our scale of effort it is closer to the concept of explanation than to direct disclosure. In addition to the aspect of effort required there is a temporal aspect involved. Today messages allow users to explain what they have done rather than allowing them to indicate what they are doing right now.

16.3.6.2 Systems Related to Indirect Disclosure

The systems discussed here, shared workspaces and tagging systems, differ in a number of ways. Shared workspaces in general are more structured, while the use of tags allows for flexibility. However, shared workspaces, tags and spheres, which are our implementation of indirect disclosure, are quite different on another level. Shared workspaces are tightly coupled with artefact. Awareness on activities in shared workspaces in general is awareness on modifications of artefacts. Tags are normally not used in an awareness context; however, they can indicate that a piece of information or an artefact belong to certain categories or a loosely defined context. Spheres in comparison are situated between shared workspaces and tags and use user-defined representations of context. They are not focused on artefacts, they rather indicate a periods of activities in a user defined context (Rittenbruch, 2002).[11]

16.4 The AnyBiff System

AnyBiff is a prototypical implementation of a direct disclosure mechanism. It is a generic tool that allows users to generate, share and use a multitude of activity indicators, referred to as "biffs". Single biffs are conceptually similar to CoffeeBiff

[11] The detailed discussion of spheres is beyond the scope of this chapter. Please see Rittenbruch (2002) for more detail on the concept.

(Fitzpatrick et al., 1999). The AnyBiff user interface consists of a multitude of vertically aligned biffs which are freely chosen and combined by the user. Users can define the set of biffs they are using by either subscribing to existing biffs or creating new biffs in order to share them with others. Anybiff exhibits the three characteristics of a direct disclosure mechanism. Users directly indicate activities by clicking on biffs which indicate certain activities. The interaction with biffs requires few interactions and is low effort. And finally, the AnyBiff concept is highly generic and allows for the creation of any type of biff that a user might require.

16.4.1 AnyBiff Design

AnyBiff is characterised by a combination of vertically aligned biffs, which can be freely created and combined by users.

16.4.1.1 Interface Elements

Figure 16.3 depicts an example AnyBiff interface. The user "Jane" has subscribed to two biffs "Lunch" and "Meeting". The lunch biff has been activated by two users, "Bob" and "Jane".

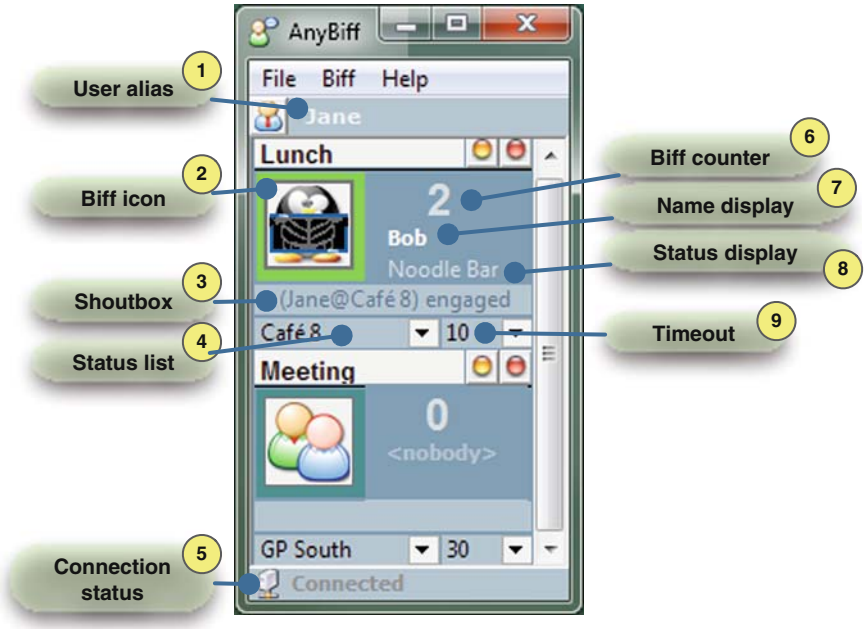

Fig. 16.3 AnyBiff interface

An icon (1) signifies a certain activity and makes it easy to visually distinguish biffs. Clicking on the icon activates a biff; clicking a second time deactivates it. The biffs serve as input as well as output interface. A counter (6) indicates the number of users that are engaged in each biff. The username of each active user will flash in a name display (7) indicating which users are engaged. In addition, the status that each user selected when engaging a biff is displayed in the status display area (8). Users can specify a timeout (9). A biff activation will expire after the time specified in the timeout has elapsed. For each activation of a biff users can select a status from the status list (4). A fixed set of statuses is pre-defined by the creator of a biff. In addition users can add custom status messages. Each biff has a shoutbox (3), which is a little tickertape style communication tool attached to each biff. Users can send and receive messages which are seen by all subscribers of the same biff. There is some minimal functionality that allows users to delete single or all messages from the scroller. Users are furthermore free to choose a user alias (1).

Each biff has two optional display modes: minimised and maximised. In maximised mode users can access all the interface features described above. In minimised mode, the display is limited to a small icon, the biff counter and the name display. Users who wish to change the status, the timeout or want to use the shoutbox need to change to maximised mode.

AnyBiff needs to be online in order to connect to the notification service and AnyBiff server. A connectivity indicator (5) shows the current connection status.

16.4.1.2 Biff Creation

Biffs are created using a Wizard. The wizard lets a user choose a name, a description and an icon for a biff. On a second screen the user can define a list of status messages for a biff. All biffs that are created are sent to the server and automatically shared with all other users of the system. There is no notion of a private biff. The existence of new biffs is indicated with an indicator icon at the user interface. New biffs are furthermore highlighted in the list of biffs from which users subscribe to or unsubscribe from biffs.

16.4.1.3 Biff Subscription

Users can select biffs from a list which is kept up-to-date on the server. The list shows the name, description and icon of each biff as well as the number and names of the current subscribers.

16.4.1.4 Notification Mechanisms

The main output for biff notifications are biffs themselves. They show all the relevant information including the number of active users, their user names and their status per biff. In addition users could choose to use sound notification to be aware of activities if the AnyBiff main window was hidden. The AnyBiff client furthermore

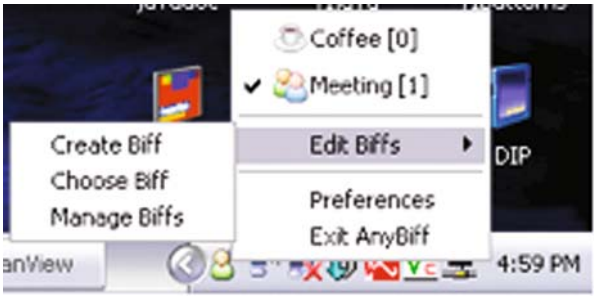

Fig. 16.4 System tray representation of AnyBiff (PC version)

integrated with the operating system it was running on. The PC version had a representation on the system tray allowing users to control and administer biffs (see Fig. 16.4). The Mac OS version integrated with the Mac specific IM application iChat. Selecting a biff would set the iChat status accordingly, e.g. selecting the Lunch biff with the status "Noodle bar" would result in a "not available" in iChat with the status line "Lunch (Noodle bar)". The different forms of integration with the operating system on PCs and Macs were caused by platform-dependent inconsistencies of the implementation framework we used.

16.4.1.5 AnyBiff Architecture

AnyBiff is based on a client server architecture. Elvin (Fitzpatrick et al., 1999), a pure notification service, is used as communication layer. Clients communicate biff selection events and shoutbox messages directly through Elvin. The client is written in Java to assure platform independence. The server consists of a biff, a status and a subscription service. The biff service administers all existing biffs within the system and propagates creation, deletion and modification events to all clients. The status services keep a persistent snapshot of the current status of all biffs. If a client connects it is provided with the current statuses of all biff it is subscribed to. The subscription service manages subscription numbers for each biff. All usage, subscription and biff modification events were logged in a database as part of the trial release of the software. Elvin was chosen in favour of language-specific communication options like Java RPC or Java JINI technology in order to allow for an easy extension of the concept with a variety of clients written in different languages.

16.5 AnyBiff Evaluation

The following section summarises some of the results gained from our evaluation of AnyBiff. See Rittenbruch et al. (2007) for a detailed list of results.

16.5.1 Methodology

AnyBiff was introduced to two research organisations. The Australasian CRC for Interaction Design (ACID) is a Cooperative Research Centre (CRC) funded by the Australian government. ACID's core activities are research, development and commercialisation in the field of the creative industries. ACID currently has 180 members including academics from participating organisations, industry participants, research assistants, post-graduate students and a small number of full-time staff. The organisation is distributed across Australia and New Zealand. The Interaction Design Research Division (IDRD) at the University of Queensland is a research group in the School of Information Technology and Electrical Engineering (ITEE) at the University of Queensland (UQ). The IDRD consists of 10 academic staff and 20 postgraduate students who are distributed over 2 campuses.

We used different AnyBiff servers and different notification services allowing us to research the use within these organisations independently from each other. The deployment of AnyBiff allowed us to evaluate its use and to address a range of research questions regarding the biff concept as well as the underlying concepts of intentionally enriched awareness in general and direct disclosure in particular. With regard to AnyBiff we were interested in how users would conceive and conceptualise the generalisation of the biff concept. In particular we were interested to observe the evolution of the mutual awareness environment that users would create by using AnyBiff. Which biffs would users create? Which biffs would become popular? Which groups of users would share biffs?

The study is based on 15 semi-structured interviews with ACID and IDRD members. We interviewed a cross section of ACID and IDRD members, including academics, postgraduate students, research assistants and administrative staff. The interviews lasted between 20 and 30 min and were semi-structured to allow for a consistent focus on a range of topic areas while leaving enough flexibility to explore particular topics in more detail. An interview guide was used to ensure that relevant topic areas were covered.

The study resulted in a rich set of qualitative data which was analysed using a number of methods. Relevant aspects from each interview were identified and aggregated using affinity diagramming. The affinity diagramming resulted in a number of topic areas that represent common themes found throughout the interviews. The data were also analysed according to the categories provided by the interview guide. Results gained from this method allowed us to see trends within particular topic areas.

In addition the usage of AnyBiff was logged at the server over the period of the trial. We gathered data on the use of biffs, on the creation deletion and modification of biffs and last on the subscription of biffs. The data gained from logging were analysed for a number of factors, including the most used biffs, the most subscribed biffs, the assignment of biffs to users and usage trends. Users were also encouraged to leave e-mail feedback on usage and conceptual issues throughout the trial. The data gathered from e-mail feedback consisted mostly of descriptions of particular

interface issues. All names that appear in quotes throughout this chapter have been altered to assure the anonymity of users.

16.5.2 Findings

The results are structured into four major subsections: AnyBiff usage, conceptual issues, biff-specific usage and GUI problems. *AnyBiff usage* refers to the use of the system as a whole and classifies the biffs that users created throughout the trial. This subsection largely relies on the analysis of system logs. The remaining sections are based on the analysis of the interviews we conducted. The *Conceptual issues* section outlines fundamental issues, relating to the usage of an intentionally enriched awareness service that became apparent during our study. The *Biff-specific usage* section summarises usage behaviour and issues that were found to be a direct result of the interaction with the biff concept, e.g. how users gauged the scope of biffs, how the biff concepts were utilised to achieve different outcomes by different users, etc. Last but not least, the *GUI problems* section summarises problems with the AnyBiff GUI. While the analysis of GUI problems were not the main focus of the study, they helped us to understand which problems were of a conceptual nature, and which ones could be attributed to implementational shortcomings.

16.5.2.1 AnyBiff Usage

AnyBiff was used by a total of 38 users at ACID and 16 users at the IDRD. About 13 ACID users created a total of 26 biffs during the trial period, while 8 IDRD users created a total of 13 biffs. A small number of users participated in both trials and created similar or identical biffs for the IDRD and the ACID system. In the context of this analysis, these biffs are counted as separate entities as they were used by different user populations.

Biff Classification

The most commonly used biffs were categorised into a number of groups in order to discern different types and approaches of biffs. The classifications include the two default biffs *Coffee* and *Meeting,* which were part of the standard installation. The classifications do not account for all biffs as some biffs were merely created by users to test and understand the concept of biffs. Figure 16.5 lists the names and descriptions of biffs (as generated by the biff creator), as well as information about which trial the biff was used in (ACID or IDRD). A number of the biffs will be discussed in more detail in subsequent sections. Biffs were categorised into six distinct groups: *location and activity indicator*, *activity inducement biffs*, *in-between awareness*, *biff concept evolution, fun biffs* and a category *other* to account for biffs that did not fit into the former categories.

The difference between activity indicator and activity inducement biffs may be a fine line. While both indicate engagement with certain activities, the second

Name	Description	Trial
Location and activity indicators		
Biffs that indicated activities and / or locations. Biffs that indicated activities often specified potential locations as biff statuses. Conversely, biffs that specified locations usually listed activities in their status lists.		
The following biffs indicated engagement in activities		
Thesis	Do you know where your thesis is right now?	IDRD
Procrastination	Working but open to chat	ACID, IDRD
Doing that work thing		ACID
Meeting	Are you in a meeting?	(default) ACID, IDRD
The following biffs indicated location in relation to a work activity		
Working at my desk		ACID
Working at home	Avoiding interruptions, but still happy to be contacted	ACID
ACID media lab	The dungeon	ACID
Activity inducement biffs		
Biffs that were used to initiate and coordinate (often social) activities with other users		
Coffee	Engage in an important social activity	(default) ACID, IDRD
Lunch	Want to have lunch, going soon, open on discussion where to go	ACID, IDRD
HackySack	Anyone interested in a game of hack?	IDRD
Choc run	Off to find some chocolate	IDRD
At the pub	At the local – join us for a drink	ACID
In-between awareness		
Biffs utilising AnyBiff's ability to sustain a notification status if a user has gone offline		
On the road	About to head between locations	ACID, IDRD
Home	Going home or at home	IDRD
Away	Far from home	IDRD
Going home now	Ciao	ACID

Fig. 16.5 Classification of biffs

category comprises biffs that are to be understood as a joining in activity (often social), while biffs in the first category are predominantly used to indicate a certain status, such as availability or location. This distinction, however, is not strict, as the pure indication of a status can lead to engagement in social activities, e.g. in the case of the biff: *Procrastination – Working but open to chat*. The question whether

biff notifications are perceived as inducements or statements is discussed in detail in section "Conceptual issues – Inducement or statement?" All other categories are discussed in detail in section "Biff-specific usage".

Biff Usage

Figure 16.6 summarises subscription and usage numbers of the most popular biffs. Usage numbers differed from the subscription numbers.

The usage behaviour reported during the interview reflected the usage figures identified by the server log analysis. Biffs were most commonly used either with the intention to initiate a social activity (mainly coffee and lunch breaks) or to indicate availability or unavailability due to participation in an activity (e.g. meetings, thesis writing). Participants who issued biff notifications were equally interested in receiving notifications about ongoing activities, including social activities as well as the location and availability of other participants.

Biff	**Subscriptions**	**Biff**	**Usage**
Most commonly subscribed biffs		**Most commonly used biffs**	
ACID		ACID	
Meeting	38 subscriptions	Working at my desk	51 uses
Coffee	37 subscriptions	Doing that work thing	42 uses
Avoiding mutants	9 subscriptions	Coffee	41 uses
Lunch	6 subscriptions	Avoiding mutants	26 uses
Doing that work thing	5 subscriptions	Meeting	25 uses
Working at home	5 subscriptions	ACID media lab	12 uses
Procrastination	5 subscriptions		
IDRD		IDRD	
Coffee	16 subscriptions	Coffee	83 uses
Meeting	16 subscriptions	Lunch	49 uses
Lunch	16 subscriptions	Meeting	44 uses
IDRD	10 subscriptions	Thesis	23 uses
On the road	7 subscriptions	Jackhammer	14 uses
		Radio silence	12 uses

Fig. 16.6 Biff subscription and usage

16.5.2.2 Conceptual Issues

Throughout our study we identified a number of fundamental issues regarding the usage of an intentionally enriched awareness service. These issues are of a conceptual nature and relate to the underlying model of intentionally enriched awareness rather than the design of the AnyBiff prototype itself.

Trade-Off Between Notification and Communication

While participants appreciated the ability to indicate intent with relative ease, they also reflected on tradeoffs between intentional notifications and communication. For instance, a number of participants appreciated the fact that coordinating activities with colleagues using biff notifications were more efficient when compared to using instant messaging for the same task. However, many participants considered it important to have chat capabilities available in addition to AnyBiff, should they require to negotiate joint activities further.

IM and chat tools were widespread and popular amongst our user population. However, a number of users complained about the potential disruptiveness of this communication approach. Those users saw AnyBiff as an alternative to quickly announce intent. AnyBiff was occasionally used in situations where users were co-located. Despite the fact that their colleagues were close they chose to use AnyBiff to indicate social activities in an unobtrusive manner in order not to interrupt their colleagues.

Inducement or Statement?

The activation of biffs can be interpreted in two fundamentally different ways. On the one hand, a notification can be understood as an invitation that announces that a certain activity is about to commence and that fellow users are invited to participate in this activity. On the other hand, it can also be interpreted as a statement that a consensus has been reached and indicates that people are already engaged in the activity. For example, seeing that four people have engaged the lunch biff can mean two things. Either these people are trying to coordinate a lunch meeting and are waiting for others to join them or they have already left for lunch. We refer to the first type of usage as *inducement* and the second type of usage as *statement*.

The reason for this potential ambiguity lies in the conceptual design of biffs. A biff does not provide facilities that will allow the user to distinguish an inducement from a statement. Designers faced with this issue can travel two different paths: They can either increase the complexity of the concept by adding additional categories. These might only be valid for a subclass of biffs. Alternatively, the designer can keep the concept simple, and instead let the users create solutions utilising existing biff facilities. Since our aim was to explore the concept behind biffs, our design rationale was to choose the second option and then observe how users would deal with this ambiguity. Our study revealed that users developed three different approaches to address this problem. First, users utilised the shoutbox to negotiate further details on joint activities. Second, special biffs were created that indicated specific induction activities. Finally, the differentiation of status messages was used to indicate whether an activity was an inducement or a statement.

A number of users suggested the creation of biffs that would be readily perceived as inducement rather than statement biffs. Participants suggested the creation of a *Ready for Coffee* or *Coffee Cravings* biff, as well as replacing the Lunch biff with a *Hungry* biff. Surprisingly, in none of these cases did users actually create any of

these alternatives. A likely explanation is that the biffs in question *Lunch* and *Coffee* were amongst the most popular biffs in the system.

Some users utilised biff statuses in order to differentiate between inducement and statement. The creator of the HackySack biff added two statuses that reflected this distinction: *Hack?* and *Hack!*. *Hack?* is an invitation and question to see whether anybody is interested in a game of HackySack. *Hack!* is the announcement that people have left to play HackySack.

16.5.2.3 Biff-Specific Usage

The following section summarises results regarding usage behaviour and issues that were found to be a direct result of the interaction with the biff concept.

Persistence and In-Between Awareness

Another aspect of biff usage is the fact that biff notifications are persistent. A notification is terminated only if a user deselects a biff or deliberately turns off AnyBiff. If the user just disconnects her laptop for instance to move to another location the notifications she issued remain active till they expire. Our participants created a whole range of different biffs[12] to exploit this behaviour.

The *On the road* biff was used to indicate whether somebody was travelling from point A to point B. The *Home* and *Going Home Now* biffs were a functional subset of the former biff and indicated whether people were on their way home from work. The *Away* biff indicated longer term unavailability due to conference travel or vacation.

Biff Concept Evolution

Participants created a range of biffs that showed new and unexpected uses of the biff concept. The appearance of these biffs is congruent with the concept of evolving use of groupware (Andriessen et al., 2003). Users will adapt tools to their needs even if the use was not intended by the designers. We will look at the *Radio silence* which extended the anticipated use of AnyBiff.

The *Radio silence* biff contained the following description: *Busy beyond belief, I'm going incommunicado till I get some work done*. The biff was created to clearly indicate that a user was not to be disturbed, while at the same time allowing a small window of connectivity for urgent matters. The creation of this biff can be seen as an effort to establish a coherent away status throughout the group. Existing *not available* statuses that users used in IM client were often ambiguous and did not give indications under which circumstances users could be contacted or not.

[12]These biffs are documented in the *in-between awareness* category in Fig. 16.7.

Localised Critical Mass Issues

The fact that AnyBiff is a generic tool combined a variety of different groups and interests led to the occurrence of an interesting variation on the critical mass issue commonly found in groupware (Grudin, 1994). We identified two localised versions of this issue. First, activities that users observe within a certain biff do not necessarily relate to their social group and can therefore be less relevant to them. Second, the critical mass issue does not only apply to AnyBiff as an application as a whole but even more so to every single biff. While some biffs became very popular, others were abandoned quickly or just dwindled away. However, unlike a failed introduction of a groupware application due to general critical mass issues, the phenomenon of critical mass per biff can be seen as part of a natural selection process of biffs. Users generate ideas and offer them up to a community and some get accepted while others are not popular enough. Another difference is that biffs do not necessarily need large user numbers to be successful. A biff can be useful to a small group of two or three people if it fulfils a specific purpose for the group.

Scope of Biffs

There are two aspects of scope with regard to biffs. The first aspect is concerned with the question of how general or specific a biff should be. Is it better to generate very specific biffs allowing for a precise expression of intent to a selected group of people, or is it better to create more general biffs that potentially address more than one activity and are likely to engage more users but are less precise? The second aspect is concerned with the interplay between biffs. Should users use one biff to indicate an activity, another biff with a different status or even multiple biffs?

It is apparent that there is a trade-off between very specific biffs on the one hand and very generic biffs on the other hand. The advantage of generic biffs is that with a minimal amount of subscriptions users can receive a maximum amount of information. Deploying generic biffs is also likely to help overcome biff-specific critical mass issues. In comparison biffs that specify more specific activities allow for a more individualised and tailored approach to both the representation of activities as well as the subscription to specific activities. Our results indicate that generic biffs were particularly useful when user numbers were low. As soon as user numbers increased, then differentiation and more specific biffs become more relevant.

Regarding the question of how users chose which biff to use, the results are less clear. Using a generic tool like AnyBiff that allows users to create any sort of biff can naturally lead to ambiguities. One of our participants reflected on this issue: “It’s interesting the different types of biff that people make and the different ways that people think about it and the ways you wrap your head around it: ‘Do I use that biff or do I use another biff with a different status?’, that kind of granularity problem.” However, in practice we observed little conflict resulting from intersecting biffs. Users were more likely to use already existing popular biffs to express their intent rather than using more obscure and less popular biffs for the same purpose. We did not observe that a biff become more popular than an intersecting biff. A longitudinal study might be necessary to gain further insight into this subject.

16.6 Design Implications

We will summarise our findings and discuss design implications centred around three key points. *Potential and challenges of intentional disclosure* summarises results from the log analysis as well as sections "localized critical mass" and "integration with social routines". *The space between awareness and communication* summarises results from sections "Trade-off between communication and notification" and "Persistence and in-between awareness" and last *Genericity, ambiguity and evolution* summarises results from sections "Induction or statement?", "Scope of biffs" and "Biff concept evolution".

16.6.1 Potential and Challenges of Intentional Disclosure

Our findings show that intentional disclosure mechanisms in the form of biffs were successfully used in two different fields of application (ACID and IDRD). Users actively engaged in the design of a large variety of biffs and explored many different uses of the concept which revealed a range of underlying issues. Challenges remain in a number of areas. With regard to the user interface, the issue of screen real estate indicates that the current implementation of AnyBiff is conceptually limited to a small number of biffs. Users on average subscribed to 3–6 biffs at a time. Interface mechanisms that would allow active biffs to be represented in the foreground while hiding inactive biffs could increase the number of biffs users can display. However, the number of biffs that a user population can sustain is limited, as we have seen in the "localised critical mass issue".

With regard to the further design of intentionally enriched awareness services different interfaces that display information with a smaller footprint need to be explored. A worthwhile approach could be the integration with IM applications allowing for a combination of different styles of interaction. Integration with an existing IM application that includes a representation of personal availability could also be instrumental in facilitating the adoption of the concept of direct disclosure to a wider user community.

16.6.2 The Space Between Awareness and Communication

Intentional notifications exist in an interesting space between event-driven awareness notifications and communication. The act of disclosing intentional information can be seen as a limited communication act. It does not require users to interact with peers beyond the initial notification. This has advantages and disadvantages. On the one hand, intentional notifications can be very efficient in quickly coordinating joint activities, especially if they build on existing routines. On the other hand, the limitations of this type of notification make it difficult to negotiate more complex situations and require supplementation with additional chat tools or verbal interaction.

Users were well aware of the trade-off between communication and notification. We observed that they used AnyBiff to their advantage where it offered enhanced capabilities over chat tools. AnyBiff was often used in situations that did not warrant direct communication. It was also commonly used even in co-located situations in an effort not to disrupt colleagues. The "in-between awareness" class of biffs showed that users capitalised on AnyBiff's ability to create persistent notifications.

With regard to the design of groupware, AnyBiff offers a unique form of user interaction that has not yet been explored in detail. The constant switch between announcement style communication and chat in order to address the varying complexities of coordinating activities further supports our hypothesis that an integration of intentional disclosure tools with chat tools like IM could be beneficial to users.

16.6.3 Genericity, Ambiguity and Evolution

Our study highlighted two kinds of ambiguities that are systemic to the biff concept. First, the question whether a biff activation is to be understood as an inducement or a statement. And second the question of the scope of a biff and whether to choose a more general or specific scope when designing biffs.

Genericity can lead to ambiguity. Generic and tailorable tools allow users to adapt software to their specific needs. The use of tailorable software in distributed settings is fraught with a range of complex challenges, e.g. Morch, 1994; Stiemerling et al., 1999. However, our study showed that AnyBiff was used despite its ambiguities. The potential weakness brought on by the concept's genericity turned out to be also one of its strength. The system evolved with its usage. Biffs were part of a natural lifecycle. Popular biffs often gained further popularity and were modified to accommodate new user populations. Unpopular biffs became marginalised and survived only if they fulfilled a very specific need for a small group of people. Biffs that explored new ideas were constantly generated and exposed to the critical eye of fellow users. The biffs summarised in the class "Biff concept evolution" show the inventiveness of our users and their willingness to explore the biff concept. While the phenomenon is by no means exclusive to AnyBiff and has been described in the context of evolutionary use of groupware (Andriessen et al., 2003) it shows that systems that offer users the opportunity to express intent can evolve and adapt to different environments. Designers of awareness systems are encouraged to take those lessons into account and allow users to express individual aspects of awareness in addition to providing standard awareness information.

Further work is needed to determine the implications of the long-term use of intentional awareness mechanisms. We expect the issue of ambiguity to intensify if the user population grows beyond its current size. Designers wishing to integrate intentionally enriched awareness into their systems might well decide to restrict, to some extent, the genericity in favour of a more standardised approach. Different notions of direct disclosure, for instance different classes for inducement or statement, or a clear indication of the scope of direct disclosure could be introduced but come at the cost of loosing flexibility. Designers will have to choose the

appropriate level of genericity based on the needs of their users and the intended field of application.

16.7 Summary and Conclusions

In this chapter we have explored the notion of intentionally enriched awareness by implementing and evaluating the AnyBiff system which allowed users to create, share and use different types of biffs. Biffs are simple widgets that allow users to announce their intention to engage in a pre-defined activity (e.g. "having coffee").

We have shown that a generalised biff concept can be an effective means to mediate different notions of announcing the engagement in shared activities within small workgroups. Our participants created a wide range of biff applications, some of which even challenge the original assumptions of the biff concept as shown in the *Biff concept evolution* class of biffs.

On a conceptual level our findings show that intentionally enriched awareness can be achieved through the implementation of a direct disclosure mechanism. The design and evaluation of AnyBiff has helped us to identify a whole range of additional challenges to our awareness model. Among those, two conceptual issues are of particular relevance: *induction or statement* and *trade-off between communication and notification*. Those challenges are located at different ends of the scale in our model of intentionally enriched awareness. We believe that our concept of direct disclosure can be logically extended in two different directions. One direction is to move direct disclosure towards communication and explanation, accounting for the *trade-off between communication and notification*. An example for such an extension is the combination of intentional disclosure mechanisms and instant messaging. The other direction, which relates to *induction or statement,* signifies a move towards indirect disclosure and uses a more structural approach to represent activity and context. The identified challenges leave ample room for further exploration of the concept of intentionally enriched awareness.

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