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Original Research

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Abstract

This paper describes the design and evaluation of NFriendConnector, a prototype application that allows for better integration between online and offline social networks. Online social networks are currently used to maintain and strengthen existing real-life social connections, rather than establishing ties that exist only online. However, users incur significant time and search related costs in replicating a naturally occurring social interaction using a social networking site (SNS). Therefore, there exists a gap between initiating social contact in real-life versus initiating social contact via an online social network. Using the design science paradigm, our research addresses this gap by introducing NFriendConnector. This application allows users to map their offline interactions, as and when they take place, onto their SNS presence, therefore making it possible to complement offline social interactions with SNS profile information. The prototype is implemented using Near Field Communication (NFC)-enabled mobile phones and Facebook. We evaluate the prototype in an experimental setting using expectation confirmation theory (ECT) as the theoretical framework. Findings show that NFriendConnector was able to satisfy users, therefore indicating a successful design exercise. We discuss the implications of this research in the context of current developments in online social networking.

Keywords: Online social networking, expectation confirmation theory, Near Field Communication, design research, prototype development, experimental evaluation

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INTRODUCTION

Online social interactions facilitated by social networking sites (SNSs) such as Facebook, Twitter, LinkedIn, and Google+ have witnessed phenomenal growth over the past few years. For instance, in the past four years, Facebook experienced an order of magnitude growth with the number of active users increasing from 30 million in July 2007 to more than 750 million in August 2011 (facebook.com, 2011). Advancements in information and communication technologies have resulted in a shift from traditional offline social interactions to an increasing convergence between peoples' offline and online social networks.

Over the past two decades, there have been diverse manifestations of online social networks (virtual communities, special interest groups, mailing lists, and the more interactive SNSs), and they tend to serve different purposes. For instance, virtual communities and special interest groups are primarily used for online connections based on shared interests or a common purpose (e.g., Wellman et al., 1996). Recent research findings, however, indicate that people increasingly use SNSs to maintain and map their offline social networks (Joinson, 2008; Lampe et al., 2006). This change in user behavior among SNS users is currently not very well-supported in existing desktop SNS applications.

Advances in information technology (IT), mobile devices and communication infrastructure (e.g., increased bandwidth, enhanced user interfaces and improved processing power) have resulted in a ubiquitousness of online connectivity. Mobile devices have become a predominant and attractive means for maintaining and strengthening social connections in real-time through mobile SNS applications (Humphreys, 2007). Studies predict that by 2012 mobile social networking users are likely to make up approximately 18% of all mobile users, the equivalent of 950 million users worldwide (Bramson-Boudreau and Arathoon, 2008).

Given the above-cited developments, our research makes use of Near Field Communication (NFC) technology (a short range high frequency wireless communication technology that is primarily used in mobile phones, and allows data exchange between devices that are four inches apart (iso.org, 2004), and Facebook to conceptualize, design, and develop NFriendConnector[1]- a prototype application for mobile phones. NFriendConnector is intended to better support the changing user behavior on SNSs (particularly on Facebook) by reducing the time and search-related costs incurred by users in replicating their naturally occurring social interactions via Facebook. It further allows users to enrich their social interactions by displaying Facebook profile information.

The development of NFriendConnector was congruent with the design science paradigm (March and Smith, 1995), and in particular, the three cycle view on information systems design (comprising relevance cycle, design cycle, and rigor cycle; see Figure. 1) as proposed by Hevner (2007). We first discuss the *relevance* of the prototype based on a use case scenario, and an assessment of current technological developments and the application environment that can be used to address the use case. Next, the technical and implementation details of the actual prototype *design* are described. Finally, as part of the *rigor* cycle, NFriendConnector is evaluated in an experimental setting using expectation confirmation theory (ECT) (Oliver, 1980) as the underlying theoretical background. The findings are discussed in the context of the relevance and design of NFriendConnector, as well as in the broader context of IS research in general.

The remaining sections of the paper are organized as follows: *Background and Related Work* Section contains a description of the design science methodology along with a discussion of prior work in social proximity applications and mobile social networking. *NFriendConnector as a Design Artifact* Section provides an outline of NFriendConnector as a design artifact, detailing its research and design gap, the design rationales and technical description, and the prototype evaluation. In *Discussion* Section we discuss the implications of this research. We end with a discussion of limitations, and the contributions of this study in *Limitations* Section and *Conclusions and Future Research* Section.

BACKGROUND AND RELATED WORK

As mentioned above, the development of NFriendConnector was loosely based on the three cycle view of design science presented by Hevner (2007). This framework was used to build and evaluate NFriendConnector as an IT artifact, and also tie it to its application environment as well as the IS scientific knowledge base. Further, NFriendConnector can be categorized as a *Social Proximity Application* which leverages ubiquitous technologies for proximity and location detection in social networks. Social Proximity Applications (SPAs) have been the center of various research projects since 2005 (Eagle and Pentland, 2005). This section provides a brief overview of the design science paradigm and previous research on SPAs.

Design Science paradigm

Design science, as defined by March and Smith (1995, p. 253), is technology-oriented research, attempting "to create things that serve human purposes" and to assess these things "against criteria of value or utility." While natural science "aims at understanding and explaining phenomena", design science "aims at developing ways to achieve human goals" (March and Smith, 1995, p. 254). The outputs of design science can be constructs, models, methods or instantiations, which were termed the "design artifact" (March and Smith, 1995). In our research, the design artifact is an instantiation in the form of the NFriendConnector application. The design of the artifact is usually grounded in the knowledge base of scientific theories and engineering methods (Hevner et al., 2004). Such design instantiations as working artifacts can lead to "significant advancements in both design and natural science" (March and Smith, 1995, p. 258).

There are two basic activities in any design science research that center on the artifact itself: building it and evaluating it. Hevner (2007) incorporates these two activities into an iterative "*design cycle*" that allows the generation and evaluation of alternatives until a satisfactory artifact is achieved. Design artifacts are usually evaluated in regards to functionality, completeness, consistency, accuracy, performance, reliability and usability (Peffers et al., 2006). Since most of these quality attributes of an artifact are closely related to its application environment, it is necessary to develop a sufficient understanding of the social, technical and organizational systems in which the artifact operates in order to avoid "inappropriately designed artifacts" (March and Smith, 1995, p. 254). Requirements for the design artifact have to be identified in the specific context of the application environment to provide a basis for building and evaluating the artifact. Further, the output of design science research needs to be studied and evaluated in the application domain via testing (Hevner, 2007). This iterative process of eliciting requirements from the application environment and field testing the artifact forms the "*relevance cycle*" (Hevner, 2007). For the design artifact to be regarded as a research contribution, the basic design science activities of building and evaluating the artifact need to be tied to the scientific knowledge base. The iterative process of grounding the artifact design and adding research insights to the existing scientific knowledge base is called the "*rigor cycle*" (Hevner, 2007).

The development of NFriendConnector followed the three cycle view (Figure. 1), by: 1) defining the problem relevance (Section *Problem Relevance*.); 2) grounding the design of the artifact with the "NFC application design guidelines" by Resatsch (2010, p. 203) (Section *Design Rationales*), and 3) evaluating the artifact in an experimental context using ECT (Oliver, 1980) as the theoretical framework (see Section *Prototype Evaluation*).

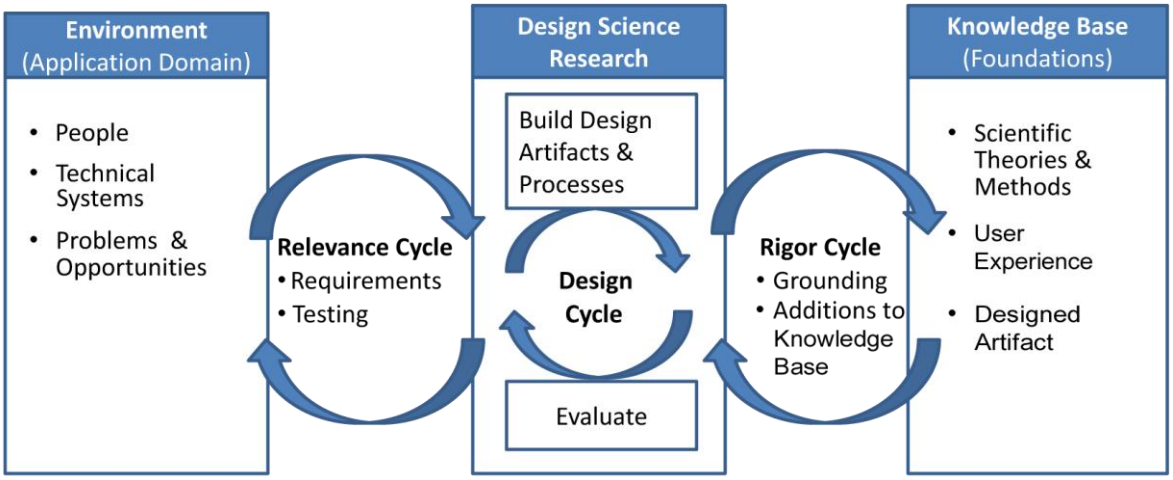

Figure 1: Design Science Research Cycles, Adapted from Hevner (2007)

Past Research on Social Proximity Applications

Given the ubiquitousness of mobile devices in general, and mobile phones in particular, a growing stream of research has started investigating the role of mobile devices in online social networking. Existing research on mobile social networking explores the use of technologies, such as Bluetooth, Global Positioning System (GPS), Wireless Local Area Network (WLAN) and similar technologies for proximity and location detection and are often called "Social Proximity Applications" (Persson et al., 2005). One of the first projects to explore these aspects of mobile social networking was Social Serendipity (Eagle and Pentland, 2005), followed by others like Dodgeball (Ziv and Mulloth, 2006) and MobiClique (Pietiläinen et al., 2009). Other applications such as DigiDress (Persson et al., 2005) and Sensor (Persson and Jung, 2005) differentiate on certain aspects of Social Serendipity, but share the same motivations and basic design rationales.

The essential idea behind these projects is to inform members regarding the location and proximity of existing acquaintances in a mobile social network, or identifying potential new acquaintances based on profile matching. Apart from the detection of an acquaintance`s location and proximity, these prototypes usually also support basic communication functions such as direct messaging (Eagle and Pentland, 2005, Pietiläinen et al., 2009, Ziv and Mulloth, 2006). However, most of these prototype systems are based on small, proprietary social networks, while only a select few like MobiClique and Cityware leverage the large user base of existing SNSs (Kostakos and O'Neill, 2008, Pietiläinen et al., 2009). The basic idea behind NFriendConnector is to build on and extend the functionality provided by Facebook, a SNS that users are probably already using, rather than having them join yet another proprietary mobile social network.

An important concern regarding mobile social networking, especially for applications making use of Bluetooth sensing is that of privacy. The implications of user names and details being made available to strangers without the user's knowledge (Eagle and Pentland, 2005) are likely to be perceived as threats to privacy. Similarly, tracking users' daily routines and preferences through their location, as done in the Cityware mobile social network (Kostakos and O'Neill, 2008) increases their privacy concerns. In contrast to the above described prototypes, NFriendConnector does not use sensory data (i.e., proximity or location) to automatically initiate profile matching or the generation of usage data. NFriendConnector requires user-initiated, near physical contact between two mobile devices (e.g., physical 'touch' between the devices) to exchange information. This full user-control of the information exchange allows NFriendConnector to overcome privacy concerns that are usually associated with typical social proximity applications.

Social Networking using Mobile Phones

Recent developments reflect the increased importance of mobile devices in the context of online social networking. This is evidenced by all major SNSs such as, Facebook, Twitter, and Google+ releasing corresponding mobile versions of their applications. Further, smartphone applications such as Bump have received significant public interest. These developments reflect a move towards providing better integration between social interactions in real lives and online social networks, therefore giving increased validation to the interaction concept that we implement in NFriendConnector.

Bump allows users to share social networking profile information along with other media data (e.g., photos, music, applications and calendar information) by bumping two smartphones together. The 'bump' is registered by accelerometers of mobile phones, and a matching algorithm running on a server infrastructure checks whether the activity was registered by another user's device running the Bump application within a proximate geo-location. After the servers communicate a positive match to the devices, users are able to share their social networking profile information via an active mobile Internet connection.

In contrast to Bump and other mobile versions of SNSs, NFriendConnector does not need to communicate with a server over a mobile Internet connection. It makes use of NFC technology to enable the exchange of social networking profile information. The use of NFC affords multiple technological advantages such as, 1) a high level of data security through asynchronous public and private key encryption; 2) a data transmission process that does not require an active mobile Internet connection (during the actual social interaction); 3) no tracking of users' geo-location information to establish a connection between two mobile phones; 4) avoidance of unintentional device matching in crowded locations because of a very short read range of NFC; and 5) a user-only initiated device matching process (in contrast to many other social proximity applications).

Despite these advantages, the focus of our research is not on the development of a mobile SNS application to compete with existing commercial offerings (such as Bump). Rather, our goal is to gain an understanding of the implications of convergence in offline and online social interactions, and how this convergence can be supported through a simple and innovative artifact design.

NFRIENDCONNECTOR AS A DESIGN ARTIFACT

In this section, we address the design and evaluation of NFriendConnector, starting with an articulation of the design gap and a description of the actual prototype design, and ending with the evaluation of the prototype application.

Problem Relevance

Let us consider a scenario where two people meet at a party, strike up a conversation, and realize that they share many common interests. They enjoy talking to each other and both want to exchange relevant contact information so that they can get in touch in future. Given the prevalence of online social networking through the use of Facebook, Twitter or Google+, it is highly plausible that these two people already have online profiles (such as Facebook profiles), and would want to establish a connection via a SNS in order to keep in touch (Joinson, 2008, Lampe et al., 2006).

To establish a Facebook connection, they each go back home, search for the other person on Facebook (provided they know his/her name), browse through all of the search results to identify the correct person, send a 'friend request,' and then wait for the other person to accept it. Therefore, while social interactions happen spontaneously and naturally in real lives, users have to incur some costs (time and search-related costs) in replicating a naturally occurring social interaction on a SNS. This illustrates that in spite of the huge popularity of online social networking, there still exists a significant gap between the initiation of social contact in real-life and such initiation via an online social network. NFriendConnector intends to address this gap by allowing users to establish a Facebook connection as and when a real-life social interaction occurs, and therefore reduces the cost of mapping offline social connections into Facebook.

There are many reasons for joining and using SNSs; for example, SNSs allow members to virtually address various human needs like self-representation, communication and curiosity by generating, sharing and combining information (Bilandzic et al., 2009). Benefits from participating in SNSs include gaining access to a wide variety of resources as well as informational, emotional and psychological support (House, 1981; Lampe et al., 2007; Leimeister et al., 2008; Wellman et al., 2001), and increased social and network capital.

Research findings indicate that in previous generations of online communities, relationships were typically initiated online based on shared interests, and were likely to transcend into users' offline worlds (Cummings et al., 2002; Parks and Floyd, 1996; Parks and Roberts, 1998), often resulting in face-to-face meetings. However, current users of SNSs mostly initiate online social ties with individuals they already know in their real lives in order to maintain or strengthen these relationships. These two different patterns of using SNSs have been referred to as "social browsing" and "social searching" (Lampe et al., 2006). While "social browsing" refers to finding (previously unknown) people or groups online in order to establish connections with them, 'social searching' refers to looking up offline contacts and acquaintances, finding out more about them, and establishing online connections with them.

There has been ongoing research focusing on SNS – such as the structure and nature of relationships within SNS (e.g., Heer and Boyd, 2005), and their implications on individual and collective behavior (e.g., Brown et al., 2007), or the benefits, risks and privacy concerns associated with using SNSs (e.g., Gross and Acqisti, 2005). However, to date there have been very few rigorous studies (one notable exception being Lampe et al. 's (2006) work) examining the changing user behavior within online communities and social networks, and the implications that the change from social browsing to social searching has for both users and providers of SNSs and other similar applications.

We present the design of NFriendConnector, an application to support the above-mentioned changing user behavior among Facebook users, and the implications of making it easier for users to be 'social searchers.' NFriendConnector intends to facilitate 'social searchers' easy replication of newly established social contacts in their Facebook profiles, using mobile NFC-enabled mobile phones to lower the cost of establishing online social ties. It also makes it possible for users to have a more enjoyable and richer social interaction by complementing those interactions with relevant information from their Facebook profiles.

Prototype Design

NFriendConnector makes use of NFC technology and the Representational State Transfer (REST) application programming interface (API) provided by Facebook along with the user's profile information. NFC is a two-way wireless data transfer with a very short operation range (less than 4 cm), similar to and compatible with radio frequency identification (RFID). It allows for an interaction-modality based on the touch-metaphor (Ailisto et al., 2006), meaning two NFC-enabled devices can exchange data when they touch each other (i.e., they are brought very close to each other). Every NFC-enabled mobile device can also act as a virtual RFID-tag and therefore allow a peer-to-peer connection between devices. Since NFriendConnector makes use of NFC technology, we drew on the design guidelines for NFC applications (Resatsch, 2010) for the scientific grounding of the design of NFriendConnector.

Design Rationales

The design rationales for the various features and functions of NFriendConnector are derived from the design guidelines for the development of mobile and ubiquitous applications (Resatsch, 2010). The design guidelines have been further classified into non-functional requirements and NFC application design guidelines (Resatsch, 2010). Table 1 lists the relevant design guidelines and rationales and their implications for the NFriendConnector design.

The primary goal of any prototype development exercise and evaluation is that of addressing a particular user need that is not currently addressed and therefore improving users' overall experience of using an application or system. In the following chapter, we will provide a design description of NFriendConnector including a technical description of the prototype system and its features.

Table 1: NFriendConnector Design Rationales

Non-functional requirements (Resatsch, 2010)	
Few navigational choices after the single top level navigational choice	NFriendConnector provides the user with an icon-based navigation (see Figure 2) following the notion of a shallow structure (Norman, 1999). Users can access all major functionalities through a single top-level choice in the navigation. Only the *"*add as friend*"* feature is realized in a more complex fashion due to restrictions of the Facebook API.
Users should be able to immediately tell the state of the device and alternatives for actions	We implemented a short message that informs users of various states of the application, such as, a positively established NFC connection, and termination of profile data transmission.
Relationship between actions and results must be clear and easy to determine	NFriendConnector is designed for a single NFC connection and data transmission at a time. After the "handshake", the prototype informs the user with a short message whether the data transmission is positive or interrupted. After the transmission, the other functionalities are uncoupled from the NFC technology itself.
NFC application design guidelines (Resatsch, 2010)	
Design for the process, not for NFC	NFriendConnector offers Facebook users the possibility of creating Facebook connections, and accessing other Facebook functionalities during the actual real-life social interaction, using their mobile devices. Consequently, the prototype supports the process of establishing online ties while the social interaction is taking place. NFriendConnector supports this by mimicking a physical "handshake" that is assisted by NFC technology.
Design trustworthy applications with clear terms of services for privacy and security	In NFriendConnector, an interaction and data exchange between users has to be intentionally initiated by users by establishing a near physical contact between two mobile devices. Since users possess full control over the exchange of the data, NFriendConnector overcomes privacy concerns that are associated with other mobile social networking or proximity applications.
Design simple applications	NFriendConnector is limited to a single layer navigational structure and five key functionalities in order to keep it simple and easy to operate on mobile devices with limited display measures and input options. NFriendConnector provides an icon-based navigation following the notion of a shallow navigational structure (Norman, 1999). Further, implemented icons are supported with a textual description of the represented functionality.
Haptic feedback in a mobile device is considered positive for usage	The use case scenarios envision a single NFC connection between two mobile devices at any point of time. We therefore refrained from haptic feedback and instead implemented a short message that informed the user of positively established NFC connections and data transmissions. We decided against other possible haptic feedback (such as vibration) based on the premise that the vibration could degrade the "handshake" metaphor.

Design Description

Mobile versions of SNSs are gaining popularity among SNS users. However, many mobile social networking applications require mobile Internet connectivity, which may not always be available for various reasons. For instance, it is difficult for a user to maintain mobile Internet access while travelling, and the cost of a roaming data connection is extremely high. Also, low signal strength may be problematic in certain places like closed rooms or inside tunnels.

NFriendConnector overcomes this problem by allowing users to perform some of the basic SNS functions even without a mobile Internet connection. Users need to have Facebook profiles and a NFC-enabled mobile phone on which the prototype application is installed and running.

NFriendConnector can be used both with and without an active mobile Internet connection. In the absence of the mobile Internet connection, NFriendConnector accesses Facebook data which has been previously stored on the phone and caches actions invoked by the user. These actions are executed and synchronized with the Facebook platform when there is access to an Internet connection. If an active mobile Internet connection is available, it uses up-to-date data from Facebook and invokes actions by the user (e.g., friend connection, the generation of a status message) on the Facebook platform directly.

To initiate a profile data transfer, users touch their mobile phones together while they are both running NFriendConnector. The Facebook profile data is transferred and each user is presented with the "Profile options" menu (as seen in Figure 2) to access the features described below.

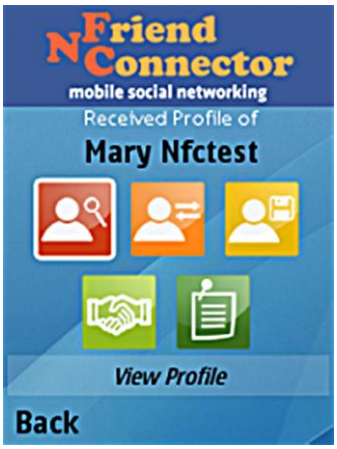

Figure 2: "Profile Options" Screen

Each user can view ("View profile") and locally store the Facebook profile of the other person on his/her mobile phone. Currently, only the profile picture, profile name, and the Facebook profile fields containing hometown, interests, movies and music are displayed as a scroll down/side scrolling list (as shown in Figure 3). It is, however, technically feasible to display all existing profile fields. Storing the profile locally allows the user to build an individual contact list of Facebook users on his/her mobile phone that can later be browsed even without an active mobile Internet connection.

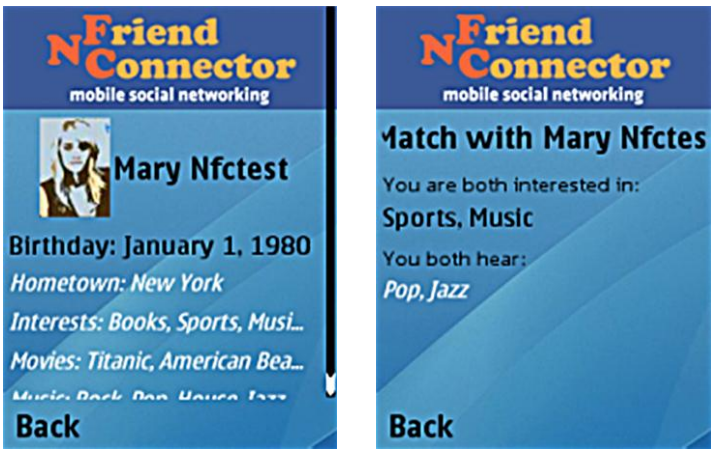

Figure 3: "View Profile" (Left) and "Match Profile" (Right) Features

The "Match profile" feature allows a user to match his/her own Facebook profile with the Facebook profile of the other person in order to identify common interests, likes and dislikes, hobbies, etc. (as shown in Figure 3). These could be helpful in partner-, relationship-, or hobby-seeking (e.g., sports), or for other matching purposes. Currently, in the prototype application, all profile fields are matched. It is also possible to set threshold for the match between certain

profile variables (such as matching only relationship status, or the distance of home towns, or number of interests, etc.) and calculate an output that signals the user of a positive or a negative match.

The prototype also provides its users access to the Facebook functionalities “Add as a friend” and “Create status message” (as shown in Figure 4). A simple example for such an automated status message could be “<individual1> is in <location> with <individual2>” (as seen in Figure 4). The location (in this case “Monaco, France”) can be obtained by the GPS receiver or cell identification mechanism of the mobile phone. The user could also define a current task (e.g., “studying”), which is then mapped onto the status message: “<individual1> is studying with <individual2>” or type in the status message directly through the keyboard of the mobile phone.

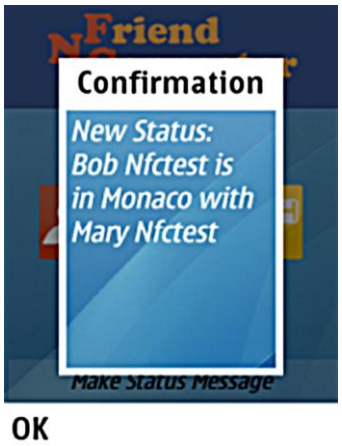

Figure 4: "Create Status Message" Feature

Technical Description

NFriendConnector has been implemented as a native Android OS application for Nexus S smartphones (google.com, 2011) and as a Java J2ME midlet on the Nokia 6212 classic NFC-enabled mobile phone (Nokia.com, 2011). The evaluation of NFriendConnector was done with the Nokia 6212 classic version (see chapter 3.3).

NFriendConnector makes use of NFC technology and the REST API provided by Facebook along with the profile data of registered Facebook users. The application environment for the prototype therefore comprises NFC-enabled mobile phones, mobile Internet broadband connectivity, and the Facebook platform.

NFC is a comparatively novel wireless communication technology that is primarily used for mobile applications, such as payment and ticketing applications (Mulliner, 2009; Ondrus and Pigneur, 2007). It uses short range high frequency wireless communication for data exchange between devices (Madlmayr et al., 2008). It is a simple extension of the ISO/IEC 14443 proximity-card standard (such as contactless card, RFID, etc.) that combines the smart card and the reader into the same device. NFC applications generally implement one of three distinct operation modes as defined by the NFC forum (nfc-forum.org, 2010):

- The *peer-to-peer mode* is used for a bidirectional communication between two NFC enabled devices. This mode enables the transfer of small amounts of information between mobile phones, e.g., contact and social networking information (Köbler et al., 2010) or Bluetooth pairing information.
- In the *card emulation mode*, an NFC device acts as a smart card which can be read by an external NFC reader. This mode is primarily used for payment and ticketing applications (Ondrus and Pigneur, 2007).
- The *reader/ writer mode* enables the NFC device to “read and alter data stored in NFC compliant passive (without battery) transponders” (Madlmayr et al., 2008, p. 642). These transponders or NFC tags can store additional information, e.g., a Uniform Resource Locator (URL) or location information for a location-based application, e.g., smart posters (Köbler et al., 2010; Koene et al., 2010).

NFriendConnector relies on the peer-to-peer operation mode for NFC applications. Users can exchange Facebook profiles by bringing two mobile phones which are running NFriendConnector into contact. The profile data is sent through the NFC interfaces of the mobile phones. The advantage of this form of communication is that no mobile Internet connectivity is required. The disadvantage is that the Facebook profile data on the mobile phone gets outdated without regular synchronizations with Facebook. Therefore, the application uses up-to-date data from the Facebook platform and synchronizes with it, whenever a mobile Internet connection is available. Figure 5 provides a

diagrammatic representation of the communication routines in NFriendConnector.

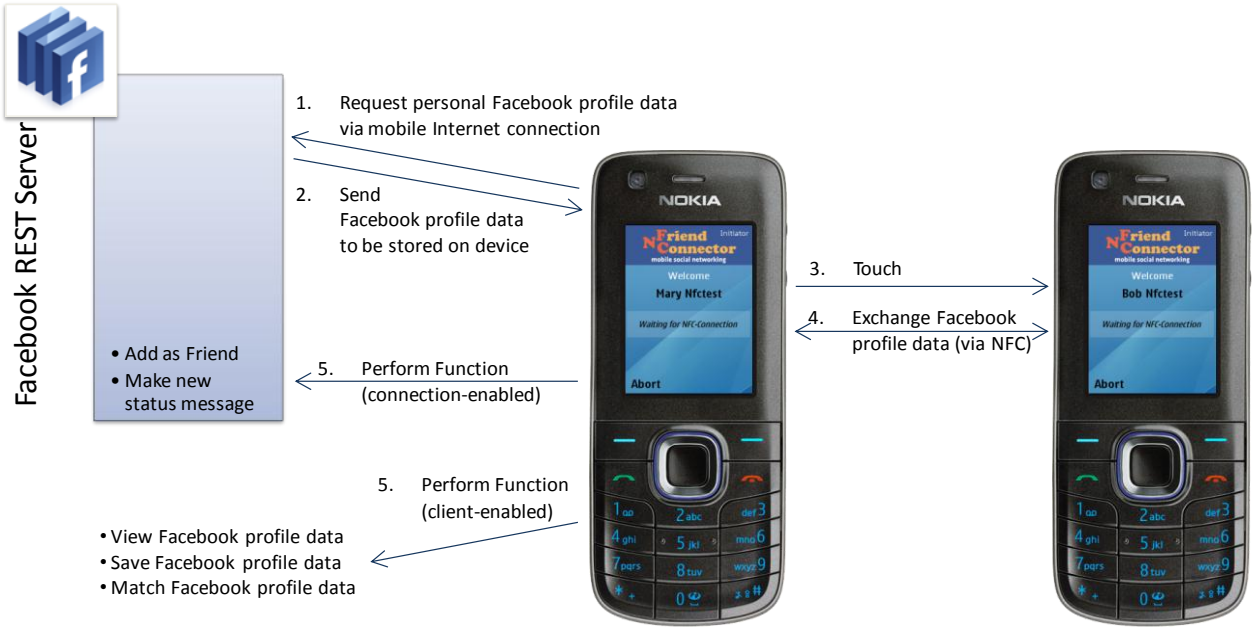

Figure 5: NFriendConnector Communication Routine

The information fields of the profile data, along with the unique Facebook user ID are stored on the mobile device and exchanged as an extensive markup language (XML) file through the established NFC connection with another mobile phone. Multimedia content of the profile (such as a profile picture) is stored locally on a user's own mobile phone but not transmitted through the NFC interface, in order to avoid very high NFC traffic and lengthening of the data exchange process. Multimedia content can be downloaded by the receiving device via a mobile Internet connection, when available.

Prototype Evaluation

A laboratory experimental setup was selected to evaluate NFriendConnector with the objective of assessing the extent to which NFriendConnector fulfills its design requirements. We expected that by satisfying an inherent user need of complementing naturally occurring social interactions with access to and information from their Facebook profiles, NFriendConnector would result in increased satisfaction among Facebook users. Satisfaction with an information system and intention to use it are recognized indicators of users' experience of using the system. The following sections provide details regarding the research model, experimental setup and the findings from our evaluation experiment.

Theory and Research Model

Selecting appropriate theories and methods for evaluating the designed artifact is a significant component of design science research (Hevner, 2007). NFriendConnector was developed to address users' changing online social behaviors. Therefore, the goal of the prototype evaluation exercise was to assess the extent to which NFriendConnector addressed users' needs and expectations from online social networking and the implications of addressing such user needs. The ultimate goal of designers is to understand how features of the designed system get embodied into users' behaviors and practices to satisfy their motivations and expectations from the system (Vasalou et al., 2010). The extent of user satisfaction can act as an evaluation of the design and implementation characteristics of a system (Wixom and Todd, 2005). Accordingly, we draw upon previous research on information system use and acceptance to identify the relevant theoretical models that can be used for evaluating the prototype.

Information system acceptance and use research is primarily based on the technology acceptance model (Davis et al., 1989; Venkatesh and Davis, 2000; Venkatesh et al., 2003) which posits that the adoption and use of different systems is determined by the extent to which users consider the system to be useful for performing certain tasks, and whether they perceive it to be easy to use. However, the technology acceptance model (TAM) usually does not take actual use experience into account in predicting the intention to use a system (Bhattacherjee, 2001). Therefore, researchers have started employing expectation confirmation theory (ECT) for investigating users' information system use and continuance intentions. ECT draws from consumer research where it is used to predict consumer satisfaction

and purchase intentions based on prior expectations regarding a product or service, and the subsequent confirmation or disconfirmation of those expectations (Anderson and Sullivan, 1993; Dabholkar et al., 2000; Oliver, 1980; Patterson et al., 1997; Pizam and Milman, 1993; Spreng et al., 1996; Swan and Trawick, 1981; Tse and Wilton, 1988). According to ECT, users are satisfied with their use experience when their expectations from the system are confirmed, and this satisfaction in turn positively influences their use and continuance intentions (Oliver, 1980). By taking the actual experience of using a system into account for predicting the intention to use, ECT provides a more realistic measure of intention to use the system, which is a key indicator of system success. Figure 6 is a diagrammatic representation of ECT, in which expectations are usually measured a priori (in time t_1), while the other variables such as perceived performance, confirmation, satisfaction and repurchase intention are measured a posteriori (in time t_2).

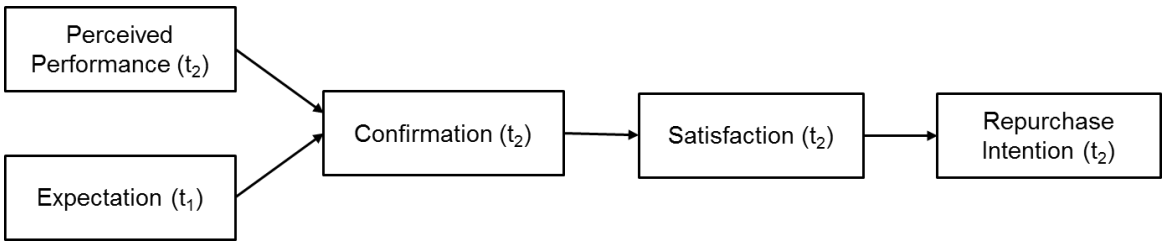

Figure 6: Expectation Confirmation Theory (ECT)

Researchers in the areas of organization behavior, psychology, consumer research and marketing, as well as information systems (IS) have developed different variations of ECT, and tested various mechanisms through which a priori expectations and a posteriori evaluations interact to result in confirmation or disconfirmation, and their implications for satisfaction with the system. Although the use of ECT in IS literature is relatively recent, six different models of expectation confirmation and its implications have been examined.

The *assimilation model*, which argues that higher expectations result in higher evaluations, has found support in IS literature (e.g., Szajna and Scamell, 1993) where it is shown that increasing users' expectations regarding system quality results in an overall increase of system evaluations. The *contrast model*, on the other hand, proposes that higher expectations lower the resulting perceptions regarding system effectiveness, and therefore overall satisfaction (e.g., Staples et al., 2002). Other models such as the *generalized negativity model* contend that realistic expectations will increase user satisfaction with the system (e.g., Goyal and Venkatesh, 2010; Tan et al., 1999), while the *assimilation contrast model* suggests setting low or accurate expectations rather than setting them high in order to increase system usage (e.g., Brown et al., 2011). The *expectations only model* (such as the TAM) shows that a priori expectations can be captured through perceptions and these perceptions predict user intentions (Davis et al., 1989). In contrast, the *experience only model* shows that a posteriori experiences play a primary role in determining perceptions (Bhattacherjee, 2001; Brown et al., 2008).

These different models can result in different strategies regarding creating and evaluating expectations depending on the context of the research. For instance, the assimilation model, contrast model, generalized negativity model, and assimilation contrast model are likely to be more useful when the study involves setting initial expectations regarding the system. However, in the context of our research, we were not interested in setting or modifying expectations, but rather in assessing users' evaluations and experiences with NFriendConnector. Therefore, we used the expectation confirmation model (Bhattacherjee, 2001), which relies on the experiences only mechanism to predict satisfaction and subsequent use intentions. The expectation confirmation model (ECM) adapts the original ECT to make it suitable for studying IS use, and accordingly provide designers with deeper insights into how to address issues pertaining to users' satisfaction with IT use and continued patronage (Bhattacherjee, 2001; Thong et al., 2006).

The ECM is an adaptation of ECT based on the experiences only mechanism and therefore focuses on a posteriori variables, instead of considering both pre- and post-use variables. The effects of pre-acceptance variables are already captured within the confirmation and satisfaction constructs (Bhattacherjee, 2001). In its original form, ECT is primarily concered with a priori expectations; however, expectations regarding a system or a product are likely to change after an initial experience with the system, and this is particularly valid in the context of IS use. Therefore, the ECM amends the theory by considering a posteriori expectations. A posteriori expectations in the ECM are represented by perceived usefulness. The ECM and the TAM are similar in that both consider individual cognitive factors for predicting IS use intents, and employ the belief-affect-intention causality route that is characteristic of most IS use and adoption research (Bhattacherjee, 2001). However, while the TAM is based on the expectations only mechanism and uses perceived usefulness to represent a priori expectations, the ECM captures post-use expectations through perceived usefulness.

The ECM predicts users' intention to use a system based on their satisfaction after initial usage. In our evaluation, users are introduced to NFriendConnector for the first time as a part of the experiment. The nature of expectations

that users' (participants in the experiment) have regarding the prototype is likely to depend on how they use Facebook. Users who use Facebook to complement their real social lives and replicate their actual social connections on the Facebook platform are likely to have different expectations about NFriendConnector compared to users who mostly establish purely online connections using Facebook. These expectations will depend on how essential they consider the functionality of being able to easily connect to their offline acquaintances using Facebook, or may be based on some pre-formed notions regarding what the prototype helps them to achieve. Irrespective of pre-existing notions, expectations are likely to be modified, and become more defined and concrete only after experiencing and using the prototype (Bhattacherjee, 2001). Therefore, keeping in line with the ECM, we examine only a posteriori variables in this study.

Confirmation of expectations results in satisfaction. Expectations form the baseline level against which confirmation is assessed by users to determine their evaluative response to a system. Users evaluate their use experience based on the extent to which their expectations are confirmed, and this evaluation results in satisfaction or dissatisfaction with the system. Satisfaction with technology has been empirically found to be associated with experience of using the technology (Mahmood et al., 2000), is dependent on the quality of the system (Delone and McLean, 2003), and is an evaluative response to system use that can be either positive, negative, or indifferent (Bhattacherjee, 2001). Therefore we hypothesized:

- H1: Users' extent of confirmation will be positively associated with their satisfaction with NFriendConnector use.

Regardless of a priori expectations that users have, after using a system they will form a posteriori expectations of the system based on its performance. Drawing from the ECM (Bhattacherjee, 2001), perceived usefulness was used to represent a posteriori expectations in this study. Perceived usefulness reflects the instrumentality of information system use and has been identified as a salient belief influencing information system acceptance behaviors (e.g., Davis et al., 1989; Taylor and Todd, 1995; Mathieson, 1991).

Users form their beliefs regarding the usefulness of a system by combining their evaluation vis-à-vis their initial expectations of the system. The extent to which users' initial expectations are confirmed after experiencing and using the system determine the extent to which they perceive the system as being useful. Therefore, we hypothesized:

- H2: Users' extent of confirmation will be positively associated with perceived usefulness of NFriendConnector.

Perceived usefulness reflects a belief regarding the usefulness of the system, and beliefs typically result in affect. Perceived usefulness is contended to be the most salient a posteriori expectation influencing users' post-acceptance affect. Satisfaction is an affect that has been found to be significantly related to perceived usefulness in the context of information system use and continuance (Bhattacherjee, 2001). Further, research has suggested that perceived usefulness and satisfaction are theoretically connected, and therefore there is a need to consider them simultaneously in research models (Wixom and Todd, 2005). Since evaluating NFriendConnector is an instance of information system use that will result in beliefs and subsequent affects, we hypothesized:

- H3: Perceived usefulness will be positively associated with users' satisfaction with NFriendConnector use.

Satisfaction plays an important role in users' decision to continue using a system. In the context of this study, users encounter the prototype for the first time, and therefore their first usage determines the formation of the affect: satisfaction (or the lack of it). Satisfaction has already been validated as a significant predictor of intention to use in various technology acceptance studies (e.g. Davis et al., 1989; Karahanna et al., 1999), while negative experiences or dissatisfaction have resulted in service termination, or discontinuance of use (Inteco, 1998). Therefore, we hypothesized:

- H4: Users' satisfaction with NFriendConnector will be positively associated with their intention to use it.

Previous research has shown that perceived usefulness is a salient belief that influences IS acceptance behaviors or behavioral intentions across a broad range of end-user technologies (Davis et al., 1989; Karahanna et al., 1999). Use of an information system is often viewed as a means to achieve enhanced performance. The extent to which the system is perceived as useful sub-consciously invokes cognitive decision rules regarding behavioral intentions (Davis et al., 1989). Therefore, in addition to a relationship between perceived usefulness and satisfaction, we also hypothesized a direct link between perceived usefulness and the intention to use NFriendConnector:

- H5: Perceived usefulness will be positively associated with the intention to use the NFriendConnector.

Figure 7 represents the research model for the study. All the variables in our study were measured a posteriori, i.e., after users had already used NFriendConnector.

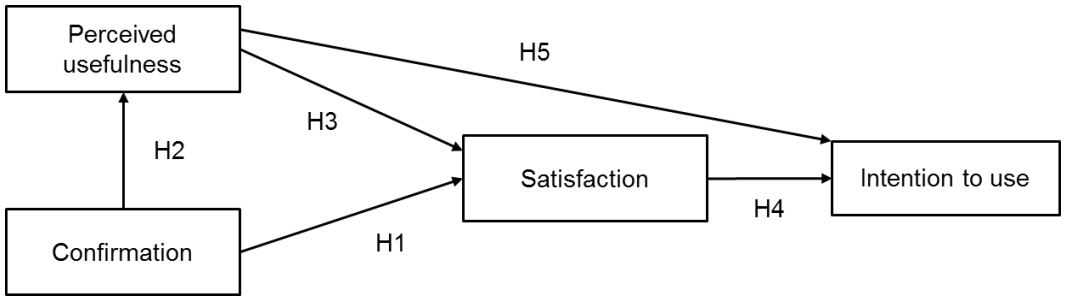

Figure 7: Research Model

Setup of the Evaluation Experiment

We chose an experimental methodology to evaluate NFriendConnector and test the hypothesized relationships. For this research, a laboratory experiment was an appropriate methodology as it allowed us to control factors that are extraneous to the variables of interest. For instance, we controlled for external factors by holding the experiment in a common laboratory and using the same NFC-enabled mobile devices (same make and model) (see section *Technical Description*).

Students registered in the undergraduate or graduate programs in a large German university were recruited as participants. The evaluation was advertised during lectures and also on posters which we hung on student bulletin boards at the university. Participants were chosen from among students who voluntarily indicated their interest in participating in the evaluation. The evaluation was held over multiple sessions in a designated laboratory. Each experimental session lasted for about 30 minutes. All sessions followed a standard protocol. Participants received a brief introductory description about NFriendConnector, its various features, and possible uses of the prototype. We then demonstrated how participants could use the prototype. Following the demonstration, participants received NFC-enabled mobile phones which had the prototype installed, and they were asked to evaluate the prototype. We paired participants and asked them to use NFriendConnector to establish Facebook connections with each other. Multiple dummy Facebook accounts were created and participants worked with these accounts, rather than their personal Facebook accounts, to ensure that all participants worked with similar types of Facebook profiles. The laboratory was equipped with desktop computers so that participants could log in to Facebook and see that the connection had actually been established.

Each participant was required to complete two short questionnaires which measured the variables of interest. The first questionnaire was completed at the beginning of the experiment, before the participants were introduced to the prototype, and mainly collected demographic information such as age, educational level, and whether they were Facebook users or not. The second questionnaire was completed after the subjects had used NFriendConnector, and measured the experimental variables such as confirmation, perceived usefulness, satisfaction, etc.

Validated instruments from previous research were used to measure the different variables (Bhattacherjee, 2001; Davis et al., 1989) (Table 2). Where necessary, the measurement items were modified to suit the context of this study. All items were measured using 5-point Likert scales, with scale anchors varying from 'Strongly Disagree' to 'Strongly Agree.' For satisfaction, users responded on four different scale anchors: Very Dissatisfied – Very Satisfied, Very Displeased – Very Pleased, Very Frustrated – Very Contented, Absolutely Terrible – Absolutely Delighted.

No time limits were imposed on the participants, as the main purpose of the experiment was to allow them to get a better understanding of the prototype and explore its features in addition to performing the task of establishing a Facebook connection with their experimental partner. Most subjects spent about 15 minutes evaluating the prototype.

Data Analysis and Findings

Table 3 reports the demographic details of the experimental sample. A total of 62 individuals participated in the experiment (N=62). Being a Facebook user was not a pre-condition to participate in the experiment, and the data indicate that roughly two-thirds of the participants were Facebook users and one-third were not users of Facebook. However, almost all participants had used some other SNS (such as LinkedIn or Xing, a highly popular SNS in Germany). Most participants were pursuing a Bachelor's or Master´s degree at the university, and were under 35 years old. Given that participants were volunteers who opted to participate in the experiment, we did not explicitly try to control for the number of male and female participants; most participants were male.

Table 2: Measurement Instrument

Variable (Source)	Measurement Items
Confirmation (Bhattacherjee, 2001)	• My experience of using NFriendConnector was better than what I had expected. • The functionality provided by NFriendConnector was better than what I had expected. • Overall, most of my expectations of using NFriendConnector were confirmed.
Perceived usefulness (Davis et al., 1989)	• Using NFriendConnector would improve my performance in establishing Facebook / [online social network] connections with friends and acquaintances. • Using NFriendConnector would enhance my effectiveness in establishing Facebook / [online social network] connections. • Using NFriendConnector would increase my productivity in managing my Facebook / [online social network] connections. • I find NFriendConnector to be useful for establishing Facebook / [online social network] connections.
Intention to use (Davis et al., 1989)	• Assuming that I have access to NFriendConnector, I intend to use it. • Given that NFriendConnector is available to me, I predict that I will use it.
Satisfaction (Bhattacherjee, 2001)	• How do you feel about your overall experience with NFriendConnector use?

Table 3: Sample Demographics

Demographic Variable	Categories	Frequency (*N*=62)
Age	Under 25	26 (41.9%)
	25 – 34	35 (56.5%)
	Over 35	1 (1.6%)
Gender	Female	8 (12.9%)
	Male	54 (87.1%)
Educational Status	Bachelor´s	24 (38.7%)
	Master´s	26 (41.9%)
	PhD	6 (9.7%)
	Not specified	6 (9.7%)
Facebook User	Yes	39 (62.9%)
	No	23 (37.1%)
User of other SNS	Yes	59 (95.2%)
	No	3 (4.8%)

We tested our research model using partial least squares (PLS; in particular, the SmartPLS application) which allows the assessment of the measurement model and the structural model simultaneously. We assessed the measurement model for reliability and convergent and discriminant validity, and the results are reported in Tables 4 and 5.

As shown in Table 4, the composite reliability was above the suggested threshold of 0.7 for all variables (Chin, 1998a; Chin, 1998b; Straub, 1989), thus supporting the reliability of the measures. In PLS, composite reliability relies on actual loadings to compute the factor scores and is a better indicator of reliability than Cronbach's alpha (Ranganathan et al., 2004). Convergent validity measures the correlation among item measures of a given construct using different methods of measurement. Table 4 presents information about the factor loadings of the research

variables. All items had nificant path loadings at the 0.001 level. The average variance extracted (AVE) values were all higher than the recommended value of 0.5 (Fornell and Larcker, 1981), therefore indicating acceptable convergent validity.

Table 4: Psychometric Properties of Measurement Model

Construct	Items	Factor Loadings	Composite Reliability	AVE
Confirmation	Confirm1 Confirm2 Confirm3	0.8122 0.7291 0.6796	0.7855	0.5511
IntentionUse	IntentUse1 IntentUse2	0.9694 0.9622	0.9653	0.9328
PerUsefulness	PerUse1 PerUse2 PerUse3 PerUse4	0.8972 0.8680 0.6347 0.8696	0.8929	0.6794
Satisfaction	Satisfac1 Satisfac2 Satisfac3 Satisfac4	0.7947 0.7286 0.6643 0.7909	0.8336	0.5573

Table 5 reports correlations between the constructs, with the diagonal elements reporting the square roots of the AVE, which were all found to be higher than the correlations between constructs. This pattern indicates that more variance is shared between a variable and its measurement items than with another variable represented by a separate set of measurement items, and is therefore indicative of discriminant validity.

Table 5: Correlation between Variables

	Confirmation	IntentionUse	PerUsefulness	Satisfaction
Confirmation	**0.7424**			
IntentionUse	0.3358	**0.9658**		
PerUsefulness	0.3719	0.5675	**0.8243**	
Satisfaction	0.6115	0.6375	0.6016	**0.7465**

Note: Diagonal elements are the square root of AVEs.

Figure 8 reports the results of path analysis. Perceived usefulness and Confirmation together explain about 54% of the variation in Satisfaction with NFriendConnector, and the overall research model explains 46% of the variation in Intention to use NFriendConnector. We tested the significance of the relationships using the bootstrap sampling procedure. All hypothesized relationships were found to be significant.

In addition to testing the hypothesized relationships, we controlled for several extraneous factors that might have affected the findings. It was found that demographic variables such as gender and age did not affect the responses. Since our sample comprised both Facebook users and non-users, we also tested whether this affected any of the variables of interest. Subjects' Facebook usage status did not affect Confirmation and Perceived usefulness. However, Facebook usage was significantly associated with Satisfaction, and the Intention to use NFriendConnector. Table 6 reports the ANOVA results for Facebook users and non-users. Facebook users reported slightly higher satisfaction (M=3.65, SD=0.54) compared to non-users (M=3.41, SD=0.49). Also, Facebook users had a higher Intention to use the prototype (M=3.38, SD=0.95) than Facebook non-users (M=2.67, SD=1.34).

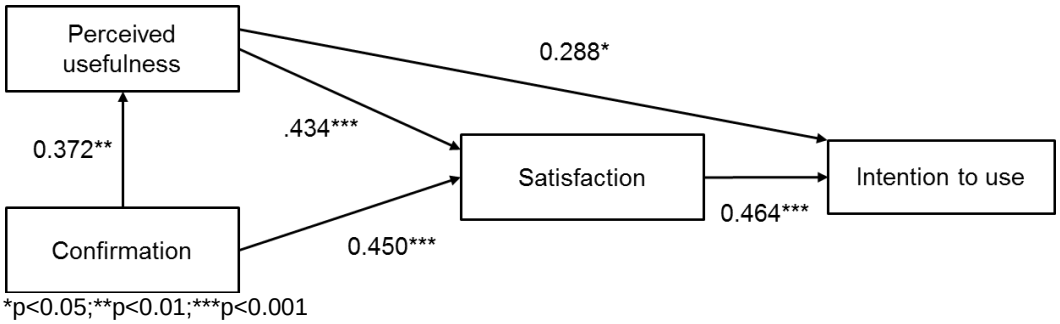

Figure 8: Results of Hypotheses Testing

Table 6: Analysis of Variance for Facebook Users and Non-Users

		Sum of Squares	df	Mean Square	F	Sig.
Confirmation * FB_User	Between Groups (Combined)	.065	1	.065	.188	.667
	Within Groups	20.940	60	.349		
	Total	21.005	61			
PerUseful * FB_User	Between Groups (Combined)	.728	1	.728	.885	.350
	Within Groups	49.349	60	.822		
	Total	50.078	61			
Satisfaction * FB_User	Between Groups (Combined)	.839	1	.839	3.045	.086
	Within Groups	16.528	60	.275		
	Total	17.367	61			
UseIntent * FB_User	Between Groups (Combined)	7.308	1	7.308	5.922	.018
	Within Groups	74.035	60	1.234		
	Total	81.343	61			

A prototype design exercise is considered successful when the target group of users finds the application useful and is willing to use it. Our results suggest that participants perceived NFriendConnector as a useful application. Satisfaction and Perceived usefulness were found to be significantly associated with users' intention to use the prototype. Satisfaction was also found to be significantly associated with Perceived usefulness and Confirmation. In addition to evaluating NFriendConnector, our study provides empirical evidence to the applicability of the expectation-confirmation model in the context of information system adoption and use. The finding that Satisfaction with the system was a strong predictor of the Intention to use shows that the experiences only mechanism of expectation confirmation seems to be a valid theoretical perspective for evaluating the effectiveness of system design. In line with the findings of Bhattacherjee (2001), the experimental results indicate that Satisfaction was a stronger predictor of Intention to use than Perceived usefulness. Since Satisfaction is grounded in users' first-hand experience with the system, it is believed to be more realistic, unbiased, and less susceptible to change (Fazio and Zanna, 1981), while Perceived usefulness could be also based on cognitive beliefs formed via second-hand information received from various sources.

Regardless of whether subjects were Facebook users or not, they perceived the prototype as useful (reflected by no significant difference in the mean values of Perceived usefulness for the user and non-user groups). This finding has important implications for both researchers and practitioners because it indicates that the Perceived usefulness of the prototype is not restricted to the Facebook platform, but can be generalized in the context of other SNS as well. This further indicates that NFriendConnector addresses a fundamental gap in the functionality provided by current SNSs. At the same time, we found that Satisfaction and Intention to use were significantly associated with Facebook usage; possibly because subjects who were not using Facebook assumed that the prototype was unlikely to be available on their SNS of choice, and therefore they reported lower levels of satisfaction with and intention to use the application.

DISCUSSION

Current research and practical developments in the area of online social networking reflect that there has been a shift in the behavioral patterns and intentions of users of various online social networks. This shift has been towards a closer association between socializing in real life and the use of SNSs (boyd, 2004, Joinson, 2008). Technological developments such as more advanced and interactive mobile phones, wireless technologies for communication among devices (such as Bluetooth and NFC), and increasing bandwidths of mobile Internet connectivity provide system designers with a wide-range of opportunities to address this shift in user behavior. Developments in practice also reflect various attempts to address this behavioral shift. For instance, innovative applications such as Bump (bu.mp, 2010) have become highly popular. Bump was originally designed for the exchange of contact information, but currently also allows for the establishment of connections on online social networks.

However, there have been few theoretically grounded studies which examine this changing user behavior, and how systems and applications can be designed to address this gap in users' motivations for using SNS and their expectations from those SNSs by making use of the various opportunities that modern technologies offer. The design and evaluation of NFriendConnector has addressed this gap through the development of an application prototype which supports the changing user pattern, and therefore enhances satisfaction with the system and the intention to use it. Our study further contributes to IS research by showing the applicability of expectation confirmation theory in the context of system evaluation. Our evaluation indicated that regardless of whether participants were Facebook users or not, they considered NFriendConnector a useful application, which might have resulted in satisfaction with the application and intention to use it. This gives indirect validation to the claim that our prototype indeed addresses users' expectations, although in this study we did not attempt to explicitly capture those expectations. In the current study, we only captured experiences with the system and the resulting effects of such experiences on perceived usefulness, satisfaction and the intention to use the application prototype. Future research can evaluate such applications (NFriendConnector, Bump, or other similar applications for online social networking using mobile phones) with a longitudinal design, and test other models of expectation confirmation such as the assimilation model or assimilation contrast model. In fact, while this study was primarily concerned with evaluating the prototype, future research can investigate factors that influence continued patronage of such mobile applications for online social networking, given that these applications are usually not intended to serve purely utilitarian purposes, but rather targeted towards making the users' SNS usage a more enjoyable experience.

LIMITATIONS

The NFriendConnector application, as well as the evaluation study should be interpreted in the context of its limitations. NFriendConnector demonstrates means of providing real-time and ubiquitous access to online social networking by extending some features of Facebook into NFC-enabled mobile devices. Therefore, the current implementation is a proof-of-concept specific to Facebook and requires NFC-enabled mobile phones. Further, NFriendConnector supports only a limited set of Facebook functionalities. A full application should be able to provide better support to users' online social networking behavior by incorporating more features and functionalities.

The prototype was developed based on research findings indicating that current users often use SNSs for connecting with and keeping up with their offline friends and acquaintances, rather than creating purely online connections. This holds particularly true for Facebook, where the direction of social networking is often from offline to online (Lampe et al., 2006). Therefore, NFriendConnector is only based on Facebook, as it was not practically feasible within the context of this study to develop and evaluate similar prototypes supporting other SNSs. There are already implementations of applications (e.g., Bump) which provide similar features and functionalities, indicating that this pattern of usage is becoming more popular in online social networking as a whole and not just Facebook. Therefore, future research endeavors may be targeted towards enhancing the generalizability of the prototype to other SNSs and evaluating its usability in different use contexts. Further, research could be carried out to investigate the use of more practical implementations of such applications (for instance Bump or similar applications).

Evaluating the prototype in an experimental setting gives rise to limitations that are inherent to this research methodology. Future studies could assess usability in more natural social settings where users are less likely to feel constrained by an experimental setup. In our evaluations, each session lasted about for about 30 minutes; participants spent about 15 minutes of that time actually evaluating and using the prototype. While this 15 minute evaluation period may have affected the stability of users' perceptions regarding the usefulness of the prototype, it can be considered sufficient for initial evaluation and acceptance of the prototype. However, future studies that allow participants to use and evaluate the prototype over a longer period of time could be designed to get a better gauge of their feelings about and experiences with the prototype and their willingness for continued patronage. Previous research has argued that the use of student subjects does not necessarily affect the generalizability of results (Campbell, 1986; Dipboye and Flanagan, 1979), and therefore the use of student subjects and university graduates does not raise serious concerns in this study. Further, our sample is generally reflective of the online social

networking user profile, and most subjects were not just Facebook users but also had experience with using other online social networks.

CONCLUSIONS AND FUTURE RESEARCH

In spite of the growing popularity of online social networking, and an observed trend towards using online social networking to complement real-life social networks, currently, there is very little theoretically grounded understanding of the behavioral and use-related intentions of users of online social networks, and how technological interventions can be designed to support such intentions. Identifying this gap, we conceptualized a mechanism for seamlessly connecting actual socializing and online social networking using mobile phones, and assessed prospective users' beliefs, perceptions and intentions towards using such systems.

We implemented NFriendConnector as a proof-of-concept in a research context The prototype allows users to make Facebook connections and also access some other Facebook functionalities using NFC-enabled mobile phones. In this paper, we have outlined the design and implementation of NFriendConnector, along with an evaluation of our prototype design using the expectation confirmation model in an experimental setting. The findings suggest that prospective users perceive the prototype as useful and are satisfied with it. Further, they indicate an intention to use the prototype if it is available to them. This provides empirical validity to our proposition of providing seamless social networking using mobile phones.

Our experimental results further indicate that even users who do not use Facebook perceive the prototype as useful and are satisfied with it. This indicates that there is significant potential for similar applications from a social interaction perspective in conjunction with various other online social networks. For instance, being able to exchange contact information and establish connections may be particularly useful for SNSs such as LinkedIn, which is a predominantly professional and business-oriented SNS. Thus, the functionality provided by NFriendConnector can be thought of as the exchange of "online business cards," where NFC-enabled mobile phones would allow users to exchange their contact information and professional interests even without having a mobile Internet connection. Future research could therefore support similar functionalities for other online social networks that are targeted toward different user groups. Finally, more comprehensive, long-term studies should be designed and executed to assess the extent to which different groups of users find the application useful and how its usage influences their online and offline social networking behavior.

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[1] NFriendConnector is a fully functional and usable application with limited features. We use the terms prototype application, prototype, and application interchangeably to refer to NFriendConnector.

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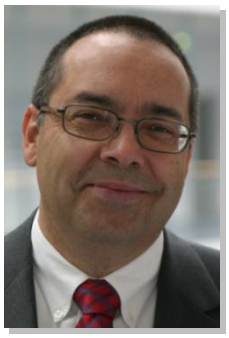

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