Abstract
Past research has suggested that social networking sites are the most common source for social engineering-based attacks. Persuasion research shows that people are more likely to obey and accept a message when the source’s presentation appears to be credible. However, many factors can impact the perceived credibility of a source, depending on its type and the characteristics of the environment. Our previous research showed that there are four dimensions of source credibility in terms of social engineering on Facebook: perceived sincerity, perceived competence, perceived attraction, and perceived worthiness. Because the dimensionalities of source credibility as well as their measurement scales can fluctuate from one type of source to another and from one type of context to another, our aim in this study includes validating the existence of those four dimensions toward the credibility of social engineering attackers on Facebook and developing a valid measurement scale for every dimension of them.

1. Introduction
Deceiving or influencing people to provide critical information or to perform an action that will benefit the attacker is known as “social engineering” [44]. Several researchers have investigated and highlighted the risks associated with social engineering in SNSs (e.g., [21], [3], [5], [29], [46], [32], [1], and [16]). Those studies suggest that SNSs are among the most common source of social engineering threats. Social engineering always comes as a message containing a request. This request can be direct, or it can be a trick that requires the victim to accept or respond to the request. For decades, marketers, advertisers, politicians, professionals of various areas, and researchers in many fields have investigated the effects of source characteristics on changing the beliefs, attitudes, or behaviors of the audience toward accepting a message. A highly credible source is commonly found to induce more persuasion toward the acceptance of the message than a low-credibility one (e.g., [51] and [34]). According to source credibility theory, people are more likely to obey and accept a message when the source presents itself as credible [31].

Defining source credibility in the previous studies is often confusing because of the many different operationalizations. The definition most closely related to our purpose is that of Ohanian 1990, where he defined source credibility as “a term commonly used to imply a communicator’s positive characteristics that affect the receiver's acceptance of a message” [48]. Since credibility is a complex concept that is composed of other concepts called dimensions, many factors can impact the perceived credibility of a source, depending on the characteristics of the medium, the channel, or the environment [42]. Several dimensions of source credibility have been proposed for different contexts, and there seems to be no agreement on these dimensions (e.g., [37]; [34]; [25]; [41]; [57]; [38]; [10]; [48]; [61]; [23]; [59]; [18]; [6]; and [54]). Therefore, it is essential that, if we wish to study the credibility of a social engineering attacker on SNSs, a specific investigation has to be conducted specifically for that purpose. While there are several studies that have investigated the dimensionality of the source credibility concept and provided suggested scales for the measurement of credibility, none of them have investigated source credibility in terms of social engineering within the environment of SNSs, or even real-life situations. In this paper, we aim to validate source credibility dimensions in terms of social engineering within the environment of Facebook, and develop a valid measurement scale for every dimension of them.
2. Conceptualization

Between-method triangulation, including observation, interviews, and an open-ended questionnaire, was conducted in our previous work [2], and [4] to explore (qualitatively) the dimensions of source credibility in terms of social engineering attacks on Facebook. As represented in Figure 1, four potential dimensions of source credibility pertinent to social engineering on Facebook were found: perceived sincerity, perceived competence, perceived attraction, and perceived worthiness. In the following sections we present overall summary about those four dimensions based on our previous qualitative work and supportive theoretical evidence from literature.

![Figure 1. Source credibility dimensions in terms of social engineering on Facebook.](image)

2.1. Perceived sincerity

Sincerity is the degree to which the message receiver perceives the source as honest and free from duplicity. Source characteristics related to sincerity were repeatedly mentioned in the interviews that we have conducted in the qualitative phase. The characteristics under this dimension include honesty, trustworthiness, and believability. For instance, Interviewee_Number 2 explained that honesty is her primary criteria in deciding whether to accept or reject a request:

*The first thing I would think about is honesty ... you know, I have to make sure that he is not lying to me.*

Participants also cited some other factors that they consider when judging a Facebook user’s sincerity. For example, when Interviewee_Number 3 suspects that another user is a scammer, he usually looks at that user’s number of friends and the amount of content in the user’s account:

*If it is not clear who the person is, the request can wait, maybe until I remember who the person is. If I’m certain that it is a scammer, I would make sure that it is not a fake profile by checking the user’s number of friends and the amount of content in the user’s account.*

Having a friend in common with the requestee has been reported as a factor that reduces the level of suspicion. For example, Interviewee_Number 1 mentioned that when she receives a friend request from a stranger, she checks if they have any common friends:

*When I see that we have common friends, I say to myself, “Maybe the system suggested that he add me to his friend list,” so I accept the invitation.*

Interviewee_Numbers 2 reported another factor that reflects sincerity, namely common beliefs:

*As you know, there are many political and religious persecutions and issues now, so having the same religion can make you sympathize with someone. I think it encourages you to help.* (Interviewee_Number 2)

In addition, the use of a nickname has been cited as suspicious. Therefore, the use of a person’s real name or a common name can reflect sincerity. For instance, Interviewee_Number 16 indicated that he does not trust people who use nicknames:

*I would suspect that, in the vast majority of cases, users who use nicknames are trying to be cute. I think they are trying to hide their reality from others and there must be a reason for that. If a person is quite confident about his attitude, he would not hide his real identity.*

The role of perceived sincerity is explained in the literature by the factor model of *Source credibility theory*, which helps determine to what extent the receiver judges the source as credible. Perceived sincerity of a source makes the victim feel safe and therefore not perceive the threat. Safety, is the feeling of being protected from danger and risk. According to Pyszczynski, Greenberg, and Solomon, (1997), when people are threatened, they will alter their behavior depending on the number of risks they can accommodate. This modification is a psychological reaction that is determined by the seriousness of an attack and the amount of loss that they think will incur because of the occurrence of a hazard [52]. This can explain how participants make judgment about sincerity of a source based on information available on the source profile such as number of friends, number of posts, using real name, and so on, which can give them perhaps some indications about the risk associated with such a source.

2.2. Perceived competence

The second dimension of source characteristics that influence Facebook users to judge others as credible is
the source’s competence or expertise. This concept represents the quality of being adequate and possessing a required skill or capacity. Three characteristics observed in the data reflect the dimension of competence: qualifications, celebrity, and wealth.

Interviewee_Number 11 indicated that he looks at SNSs, including Facebook, as free environments that support forming networks:

I don’t know if you agree with me or not, but I think that the primary benefit of social networks, including Facebook, is that they allow you to build a network of qualified and expert people in your field. The only thing you need to do is send them a friend request. You lose nothing if they reject it!

Another example, regarding celebrity, was observed in the account of Interviewee_Number 15. Through observation, the researcher found that this participant “liked” (i.e., followed or subscribed to) more than 40 celebrities from different countries and in different areas, such as sports, writing, acting, music, and fashion. She explained this as follows:

P: I love to follow every aspect of celebrities’ lives… You know, we always see them on TV, in the newspapers, and in the movies. They have become a part of our lives. I consider it reasonable to find myself trusting them or eager to communicate with them.

The third characteristic related to competence is wealth. Interviewee_Number 13 shared a friend’s bad experience in which a scammer deceived her by pretending to be wealthy:

One of my friends used to know a man on Facebook who pretended to be a rich person. After a couple of months of chatting with each other on Facebook, he said that his business was in trouble and that he needed to borrow a couple of thousand dollars from her. Unfortunately, my friend trusted him and gave him the money. Immediately after receiving the money, the man removed her from his friend list and disappeared.

The impact of perceived competence is strongly associated with trust in the literature. Trust has been studied in marketing in relation to persuasion, and it has been found that the characteristic of trusting people in advertisement is important in formulating marketing persuasion [15]. Retailers utilize this weakness to persuade users that they have the endorsement of celebrities, high qualified, and wealthy people [17]. It has been shown through research that most people are drawn closer to individuals they are fond of and they end up developing trust for them [55]. This explains why people tend to believe online professionals even if their expertise is not reflected in the profiles or sites that they operate. Trust has been studied in information systems as well, and it has been found that there is a strong relationship between trusting beliefs and trusting intentions [60]. This, therefore, leads users to become vulnerable to the trustee sources in a situation of uncertainty [60].

2.3. Perceived attraction

The dimension of attraction represents the feature or the quality that evokes interest and liking. Two characteristics observed in the data reflect the dimension of attractiveness: good looks and good writing skills. For instance, Interviewee_Number 6 mentioned the positive effect of a user’s good looks: “Interaction with good-looking girls makes me feel good. I get an overall feeling of confidence.”

Interviewee_Number 1 also mentioned the impact of looks on her judgment. She said that the first thing she looks at when she wants to know more about somebody on Facebook is the user’s photos:

In a real life situation, it’s about attitude and personality and probably not about how bad-looking one is. But on Facebook, I would look at the photos initially to get a first impression.

Good writing skills were also identified as a vital factor that attracts others and reflects the credibility of the source:

I spend most of my time on Facebook reading others’ posts or comments, so the first thing that attracts me is good writing. When I see an impressive post or comment, I immediately look at the profile of the person who wrote it, and sometimes I send the person a friend request. (Interviewee_Number 18)

The impact of attraction on accepting a message is associated with source likability in the literature. Ben Franklin effect theory states that when we like someone we are more willing to do him/her a favor [33]. The reverse effect is also true. That is, when we do a person a favor, we tend to like them more as a result. It has been shown through research that people tend to communicate with other people because they are charming or attractive [24, 17]. Several studies have been conducted in marketing research and the results of those studies concluded that communicators who have good looks are consistently liked more and have a positive impact on influencing others [35].

2.4. Perceived worthiness

Perceived worthiness is the degree to which the source is perceived to be advantageous for the user to communicate with. In other words, it is the perceived
benefit of the source, which inspires user’s effort, respect and care. The difference between worthiness and the previous dimensions is that it represents the potential benefit that the particular user can get from a source. Some participants believe that the source must be worthy of their acceptance or response even if they believe the source is sincere, competence, or attractive. For instance, Interviewee_Number 1 said:

If I care about him so much, I’m willing to do anything for him; I support him financially, and do everything I can for him. But if I don’t care about him, I don’t think that I’m willing to do that even if I believe that he is in need.

The role of perceived worthiness is explained in the literature by the functional model of Source credibility theory, which views credibility as the degree to which a source meets a receiver's needs [31]. Politeness theory also gives further explanation about the impact of perceived worthiness on accepting social engineering request. Politeness theory states that in response to any request, people maintain one of the two following faces: a positive-based face or a negative-based face [13]. A positive-based face is one which reflects appreciating, or respecting. A negative-based face is one when there is no constraint in any way. Therefore, politeness theory indicates that people act politely or rudely depending on whether or not they care about the requester. That is, if they care about the person who requests that they do a favor (such as boss, sexual compatible), they will show a positive face; however, if someone that they do not care about makes such a request, they will show a negative face. In addition, the Elaboration likelihood model states that there are two routes or methods to influence others: the central route and the peripheral route [50]. The central route uses message elaboration and can produce a positive attitude change and encourage the receiver to obey. The peripheral route relies on a receiver’s emotional involvement and thus persuade through more superficial means. The influences that were explained by participants in regards to authority, sexual compatibility, and reciprocity are all examples of peripheral cues or routes of Elaboration likelihood model.

3. Items development process

3.1. Item sample

As suggested by Cronbach and Thorndike [19], the first step in our measurement process involves delimiting the domain of the construct and generating sample items. For validity purposes, first, we draw representative items from a universal pool including academic literature and relevant trade press articles. Our review of the literature included studies regarding advertiser credibility, company credibility, seller credibility, corporate credibility, salesperson credibility, communicator credibility, and spokesperson credibility (see supportive references in Table 1). Those studies have suggested tens of representative items, which showed high loadings of factor analysis, for measuring those dimensions. The researchers involved in those studies provided their participants with a number of semantic differential items with which to rate the credibility of the sources under study. The resulting data were then combined into factors through factor analysis, and then the factors were interpreted as dimensions of credibility.
While those studies provided suggested items for the measurement of the first three dimensions (perceived sincerity, perceived competence, and perceived attraction), the literature shows a lack of research regarding the fourth dimension of credibility (perceived worthiness). Perceived worthiness is a new dimension that emerged from our previous research; the literature shows a lack of research dedicated to measuring this dimension. Therefore, we consider some items that have been used in the literature to measure some related constructs, but we rely most on the interview results that have been done in our previous work, which will be explained next. Because different names and expressions are used by researchers for the dimensions that they found and have loadings on identical items, all of the scales with high loadings on factors from those studies were included in our sample. Second, we added other potential items that have emerged from our previous work to the representative items that have been drawn from the literature. The interviews as well as the open-ended questionnaire helped in exploring additional potential items, especially for the dimension of perceived source worthiness since it has not been measured as a dimension of credibility before. These additional items have been repeatedly mentioned by interviewees and open-ended questionnaire participants during our exploratory phase. Overall, the first and second step in our measurement process yielded 112 representative items, as presented in Table 1.

### 3.2. Refinement

The sample items were assessed using the Delphi method. Five information systems scholars were asked to evaluate the items and make any necessary changes in order to eliminate repetitive, non-user-oriented, and ambiguous items. We applied this technique for the four dimensions, even those for which there were measurement items in the literature, since they have been measured for different purposes, such as marketing and teaching, and in different contexts than Facebook. After three evaluation rounds, 35 items remained in the list: 9 items for the dimension of sincerity, 7 for the dimension of competence, 8 for the dimension of attractiveness, and 11 for the dimension of worthiness. The information systems scholars deleted some items that they suggested were unrelated to social engineering-based tricks or not related to the context of Facebook, such as “right: wrong” or “natural/artificial.” The scholars also suggested adding a few items that suit social engineering or the context of Facebook such as “real account/ fake account” and “safe/ dangerous.” Table 2 shows the representative items for every dimension after applying the Delphi method’s refinement process.

Conversely, a similar technique has been used to develop social engineering questions and tricks that measure susceptibility to social engineering victimization in Facebook. We designed persuasive messages, including tricks similar to those that have been used in real-life examples on Facebook such as Koobface, Zeus, Likejacking, Facebook Black, and Who-Viewed-Your-Profile attacks (e.g., [58]; [9]; [7]; [30]; and [53]). Social engineering persuasion messages were added to those requests to encourage the participants to respond to (accept) the requests. Since we wanted to study the impact of the source who sent the trick and not the trick itself, we wrote the
messages in a way that made the participants rely more on the source who wrote the message, for example, the messages included phrases such as “I have checked this myself,” “I recommend that you download it,” and so on. Thirty-five different social engineering-based tricks have been designed for this purpose, including responding to phishing links, revealing critical information, downloading malicious software such as malware or trojans. Three information security scholars were asked to evaluate the items and make any required change. After three evaluation rounds using the Delphi method, 10 social engineering questions were chosen as the measurement for susceptibility to social engineering victimization on Facebook.

4. Experiment design

4.1. Choosing fractional factorial design

Based on the 13 Facebook-based source characteristics that influence users to judge the attacker as per one of the credibility dimensions, we designed 20 different Facebook profiles using Fractional Factorial Design, as shown in Figure 2.

The Fractional Factorial Design, allows researchers to participants’ time and efforts and it provides a good way to calculate the effect of each source characteristic individually [28, 20]. Using those different profiles during this exploratory factor analysis ensures having the minimum required treatments that can impact participant perception and, therefore, increase the usefulness of the data.

For some characteristics, such as sexual compatibility, we used different profiles representative of male and female. Part of the challenge in this stage was the difficulty of choosing people well known by the participants and who better represent some of the cases in the design. For example, we needed to find a celebrity who is perceived by the majority of participants as wealthy and who has a high level of qualification (case 9); a celebrity who is perceived by the majority of participants as having a low level of wealth and a low level of qualification (case 12); a person who is perceived by the majority of participants as having good looks (cases 13 and 15); a person that has a high level of sexual compatibility for the majority of males (cases 17 and 19, when the participant is male); and so on for the rest of the cases.

The same difficulty was faced while choosing cases 13 to 16 where we needed to find posts that can be perceived as impressive or good writing and other posts that can be perceived as bad writing. Therefore, this task (choosing the characters and the posts to be used in designing profiles that better represent the experiment’s cases) was done using two steps and two different groups of participants. The first group was asked to suggest or name up to three people for every case under study. A total of 93 participants have participated in this task, 44 women and 49 men. This task was performed in a computer lab where the Internet was provided to the participants to help them choose, search, take snapshots, and then email their suggestions to the researcher. Then, the people who

Table 2. Sample items after refinement

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Sample Items After Refinement</th>
<th>Supportive References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived Sincerity</td>
<td>Honest/ Dishonest; Sincere/Insincere; Believable/ Unbelievable; Trustworthy/ Not Trustworthy; Realistic/ Unrealistic; Fake-account/ Real-account; Dangerous/ Safe; Authentic/ not authentic; Unbiased/ biased</td>
<td>[37]; [62]; [11]; [25]; [59]; [57]; [36]; [10]; [45]; [27]; [43]; [48]; [61]; [47]; [23]; [18]; [6]</td>
</tr>
<tr>
<td>Perceived Competence</td>
<td>Professional/ Unprofessional; Competent/ Incompetent; Successful/ Unsuccessful; Skilled/ Unskilled; Qualified/ unqualified; Expert/ inexpert; Powerful/ powerless</td>
<td>[12]; [37]; [62]; [11]; [25]; [59]; [40]; [41]; [57]; [38]; [10]; [45]; [54]; [48]; [47]; [23]; [18]; [6]</td>
</tr>
<tr>
<td>Perceived Attraction</td>
<td>Dynamic/ static; Expressive/ inexpressive; Appealing/unappealing; Attractive/ unattractive; Exciting/ dull; Expressive/ inexpressive; Interesting/ uninteresting; Cheerful/ Gloomy; Impressive/ Unimpressive</td>
<td>[59]; [37]; [62]; [11]; [8]; [8]; [59]; [40]; [41]; [57]; [38]; [10]; [48]; [61]; [23]; [18]</td>
</tr>
<tr>
<td>Perceived Worthiness</td>
<td>Beneficial/ Unbeneficial; Worthwhile/ Worthless; Deserving/ Undeserving; Important/ Unimportant; Advantageous/ Disadvantageous; Profitable/ Unprofitable; Useful/ Useless; Valuable/ Invaluable; Laudable/ Not Laudable; Eligible/ not eligible; Vital/ not vital</td>
<td>Most of these items have been obtained from our previous qualitative studies: [2] and [4].</td>
</tr>
</tbody>
</table>

Figure 2. Experiments’ design
have been suggested more times by the first group were given to the second group, different from the first group, to rate every individual based on the characteristics under study. A total of 89 participants have participated in this task, 46 women and 43 men. The same procedures were performed in regards to choosing the posts that represent low and high levels of writing skills.

4.2 Choosing a role-play experiment

After choosing the characters (the profile owners) that will be used in the experiment, we then designed profiles for them that look similar to real Facebook profiles and added them to a role-play experimental questionnaire. In the role-play (or scenario-based) experiment, participants act out scripts, pictures, or examples based on real-life situations [63]. We used the role-play experimental questionnaire in this study by presenting the profiles, which represent the 20 cases in Figure 2, to the participants and asking them to rate every profile based on the information provided and using the items that have emerged in Section 3.2 to measure every dimension under study. Every profile was presented along with a scenario that tells the participants some information about the owner of the profile to enhance the participants’ perception regarding the characteristics of the case.

For measuring the items related to credibility dimensions, we used a 10-point semantic differential scale, which is a type of rating scale designed to measure the connotative meaning of concepts [26]. This type of scale has been widely employed in past source credibility studies (e.g., [40], [27], [14], and [22]). In addition, we asked the participants to indicate how they would respond to social engineering questions (the 10 social engineering questions that emerged in the previous section to measure susceptibility to social engineering victimization) if they were sent or posted by the owners of every profile. For measuring the participants’ behavior towards the social engineering questions, we used a 5-point Likert scale, with a rating system of “Definitely yes” = 5, “Very probably yes” = 4, “Probably yes” = 3, “Very probably no” = 2, and “Definitely no” = 1.

In order to encourage more participants and to screen out those participants who were not paying attention to the questions, we offered to pay participants five dollars for those that qualified by answering five qualifying questions, which could be answered correctly by a careful reading of the profiles’ contents and provided scenarios. In total, 120 participants qualified and completed the entire study. This is considered a good number, since it constitutes 2,400 profile observations, 20 different profiles for every participant. Around 70% of participants were undergraduate students; 30% were employees. Sixty percent were male, and 40% female.

5. Results

We first computed reliability coefficients of the scales using Cronbach’s alpha, for perceived sincerity, perceived competence, perceived attraction, and perceived worthiness. The reliability tests suggested that screening the data along would improve reliability levels. Therefore, we screened the collected data by discarding items that showed a low loading. Then, the semantic differential data were submitted to principal component factor analyses and varimax rotation. An eigenvalue of 1.0 was established as the criterion for the termination of factor extraction.

<table>
<thead>
<tr>
<th>Table 3. Factor analysis using principal component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Items</td>
</tr>
<tr>
<td>-------------------------------</td>
</tr>
<tr>
<td>Worthwhile/Worthless</td>
</tr>
<tr>
<td>Advantageous/Disadvantageous</td>
</tr>
<tr>
<td>Beneficial/Unbeneficial</td>
</tr>
<tr>
<td>Useful/Useless</td>
</tr>
<tr>
<td>Eligible/Not Eligible</td>
</tr>
<tr>
<td>Valuable/Invalid</td>
</tr>
<tr>
<td>Deserving/Undeserving</td>
</tr>
<tr>
<td>Important/Unimportant</td>
</tr>
<tr>
<td>Laudable/Not Laudable</td>
</tr>
<tr>
<td>Honest/Dishonest</td>
</tr>
<tr>
<td>Sincere/Insincere</td>
</tr>
<tr>
<td>Trustworthy/Not Trustworthy</td>
</tr>
<tr>
<td>Safe/Dangerous</td>
</tr>
<tr>
<td>Believable/Unbelievable</td>
</tr>
<tr>
<td>Authentic/Not Authentic</td>
</tr>
<tr>
<td>Attractive/Unattractive</td>
</tr>
<tr>
<td>Expressive/Inexpressive</td>
</tr>
<tr>
<td>Appealing/Unappealing</td>
</tr>
<tr>
<td>Interesting/Uninteresting</td>
</tr>
<tr>
<td>Cheerful/Gloomy</td>
</tr>
<tr>
<td>Exciting/Drill</td>
</tr>
<tr>
<td>Impressive/Unimpressive</td>
</tr>
<tr>
<td>Professional/Unprofessional</td>
</tr>
<tr>
<td>Competent/Incompetent</td>
</tr>
<tr>
<td>Qualified/Unqualified</td>
</tr>
<tr>
<td>Powerful/Powerless</td>
</tr>
<tr>
<td>Expert/Inexpert</td>
</tr>
<tr>
<td>Successful/Unsuccessful</td>
</tr>
</tbody>
</table>

Eigenvalue | 7.8 | 6.06 | 5.78 | 5.31
Variance    | 0.26 | 0.20 | 0.19 | 0.18

Varimax with Kaiser Normalization. a. Rotation converged in 6 iterations.
For an item to be considered loaded on a resulting factor, a loading of 0.60 or higher was required, with no loading of 0.40 or higher on any other factor. After several screening attempts, 29 items remained in our pool, and the reliability levels for the source credibility dimensions were 0.97, 0.96, 0.95, and 0.98 for perceived sincerity, perceived competence, perceived attraction, and perceived worthiness, respectively. As shown in Table 3, the factor analysis revealed four factors with an eigenvalue of 1 or greater, sorted by highest to lowest loading. The Kaiser-Meyer-Olkin measure of sampling adequacy came as 0.97, the significance as 0.0001, the total eigenvalue as 24.95, and the total variance as 0.86.

### 6. Discussion

The results from this study suggest the presence of four dimensions of source credibility in terms of social engineering on Facebook. We labeled those dimensions as sincerity, competence, attraction, and worthiness, as we expected them to be based on our previous exploratory qualitative phase and measurement development process. The results also suggest a measurement scale for every dimension with a high level of significance. Table 4 presents the top 6 items for every dimension. More items can be added from table 3 if needed. Figure 3 shows an example of the recommended measure using a 10-point scale for three items only, which can be applied to the rest of the items.

**Table 4. Suggested measurement items**

<table>
<thead>
<tr>
<th>Sincerity</th>
<th>Competence</th>
<th>Attraction</th>
<th>Worthiness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Honest/Unhonest</td>
<td>Professional/Unprofessional</td>
<td>Attractive/Unattractive</td>
<td>Worthwhile/Unworthless</td>
</tr>
<tr>
<td>Sincere/Incredible</td>
<td>Competent/Incompetent</td>
<td>Expressive/Inexpressive</td>
<td>Advantageous/Disadvantageous</td>
</tr>
<tr>
<td>Trustworthy/Not Trustworthy</td>
<td>Qualified/Unqualified</td>
<td>Appealing/Unappealing</td>
<td>Beneficial/Unbeneficial</td>
</tr>
<tr>
<td>Safe/Dangerous</td>
<td>Powerful/Powerless</td>
<td>Interesting/Uninteresting</td>
<td>Useful/Useless</td>
</tr>
<tr>
<td>Believable/Unbelievable</td>
<td>Expert/Inexpert</td>
<td>Cheerful/Gloomy</td>
<td>Eligible/Not Eligible</td>
</tr>
<tr>
<td>Source/Account</td>
<td>Successful/Unsuccessful</td>
<td>Exciting/Dull</td>
<td>Valuable/Invaluable</td>
</tr>
</tbody>
</table>

*Instructions:* The following are a series of attitude scales. You are asked to evaluate the Facebook user in terms of the adjectives on each scale. The presented Facebook user is:

<table>
<thead>
<tr>
<th>Dangerous</th>
<th>Unqualified</th>
<th>Worthless</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3</td>
<td>4 5 6 7 8 9 10</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safe</td>
<td>Qualified</td>
<td>Worthwhile</td>
</tr>
</tbody>
</table>

**Figure 3. Example of the recommended measure**

As suggested by McCroskey, et al. [40], the evaluation of such a measure should be based on three criteria: the reliability of the instrument, the validity of the instrument, and the ability of the instrument to predict what it is intended to measure. For the reliability of the instrument, our results showed high levels of reliability for the source credibility dimension. The reliability test resulted in 0.97, 0.96, 0.95, and 0.98 for perceived sincerity, perceived competence, perceived attraction, and perceived worthiness, respectively. For the validity of the instrument, McCroskey, et al. [40] suggest that the item pool, and thus the resulting factors and scales, are representative of the credibility construct if the pool of items upon which the instrument was built represented a wide variety of previously used scales for source credibility.

In addition, all of the dimensions appear to be related to credibility, and each of the scales seems to be logically associated with the factor on which it was highly loaded. For the ability of the instrument to predict what it is intended to measure, which is source credibility in terms of social engineering on Facebook, we tested this with the role-play experiments, which have been explained in Section 4.2, using different social engineering-based tricks, including responding to phishing links, downloading malware, revealing critical information, and others types of tricks that can be performed on Facebook and using social engineering’s persuasiveness. Out of the 10 social engineering questions that have been designed, we have used the highest 5 questions based on reliability coefficients of the scales using Cronbach’s alpha with alpha values greater than 0.80. As shown in Table 5, all of the observed correlations between the source credibility dimensions and the susceptibility to social engineering were statistically significant (p < .01), and the variance extracted is greater than the correlation square, which suggests convergent and discriminant validity.

**Table 5. Correlations among constructs**

<table>
<thead>
<tr>
<th></th>
<th>Sincerity</th>
<th>Competence</th>
<th>Attraction</th>
<th>Worthiness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sincerity</td>
<td>.389**</td>
<td>.367</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Competence</td>
<td>.499**</td>
<td>.270</td>
<td>.532**</td>
<td></td>
</tr>
<tr>
<td>Attraction</td>
<td></td>
<td>.571**</td>
<td></td>
<td>.672**</td>
</tr>
<tr>
<td>Worthiness</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Susceptibility to SE</td>
<td>.782**</td>
<td>.571**</td>
<td>.661**</td>
<td>.672**</td>
</tr>
</tbody>
</table>

**Correlation is significant at the 0.01 level**

Table 5 also shows that the four dimensions had significant effects on the predictability of susceptibility to social engineering victimization, with beta weights of 0.48, 0.31, 0.25, and 0.18 for perceived sincerity, perceived worthiness, perceived
competence, and perceived attraction, respectively. These results, therefore, indicate the validity of the developed instrument to measure source credibility in terms of social engineering on Facebook.

While this work provides significant findings, there are two limitations worth noting. First, due to the challenges of the ethical issues and to conduct the study in accordance with the National Statement on Ethical Conduct in Research Involving Humans, we have used a role-play experiment. However, various studies have confirmed the degree of realism and involvement that can be achieved in role-playing studies (e.g., [56]; and [49]). Moreover, the reliability and validity tests suggest that there is no reason to believe that the results described in this study should differ in their relationship to role-play behavior compared to real-world behavior. Second, due to space limitation as well as the focus of this study, which is developing and validating instruments to measure source credibility in terms of social engineering on Facebook, we have not presented the relationship between the findings and users’ demographics. However, this limitation should be eliminated by our next future work. As this study is part of a project that uses a sequential exploratory mixed method to predict a person’s vulnerability to social engineering victimization, our future work will use the findings of this study to conduct a larger experiment on larger sample. For our projected future exposure, and for other directions of research aimed at uncovering deception and scams in SNSs, the results indicate that the source credibility instrument that was developed in this study is a reliable measure and has satisfactory validity.

7. References