Univ Access Inf Soc (2015) 14:537–545
DOI 10.1007/s10209-014-0354-3

LONG PAPER

Enhancing universal access: deaf and hard of hearing people on social networking sites

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Published online: 17 April 2014

Abstract Despite numerous studies into the online activities of deaf and hard of hearing (D/HH) users, there has been limited research into their experiences on social networking sites (SNSs), a domain where psychology and computer science intersects. The purpose of this study is to illustrate how one can enhance universal access for D/HH users on the example of SNSs. A model for examining the experiences and preferences of D/HH users of SNSs has been proposed. The model consists of three identity-relevant aspects: (1) belonging to online Deaf communities, (2) communication affinity/preferences for sign and/or written language, and (3) the stigma associated with hearing loss. Based on these aspects, a questionnaire was developed and applied to a study with 46 participants. The findings revealed that the motivation to communicate on SNSs is positively associated with identification with online Deaf communities, an affinity for communication in written language and an affinity/preference for communication in sign language. Better reading comprehension skills, crucial for written communication, are associated with less stigmatic experiences with regard to hearing loss. The model and the findings of this study can help improve understanding D/HH users' online social interactions and can be used for educational purposes. It may contribute to the discussion of integrating SNSs as communication tools in personal learning environments, which can be an advantage for universal access.

Keywords Social networking sites · Deaf · Hard of hearing · Communication · Motivation · Identity

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1 Introduction

Within the context of Human–Computer Interaction (HCI), the concept of Universal Access [31] introduced a new perspective that promotes the accommodation of a wide range of human abilities, skills, but also limitations, constraints, requirements, and preferences in the design of information technology [13]. Obviously, this reduces the need for many special features, while fostering individualisation, the quality of interaction, and ultimately, end-user acceptance [14, 30]. The notion of Universal Access reflects the concept of an information society in which anyone can potentially interact with information technology, at any time and at any place, in any context of use, and for virtually any task [27]. However, designers and developers of this type of technology often ignore the

enormous problems, needs, demands, and requirements of the end-users, and consequently fail to examine how the end-users work, and communicate with such technologies [15]. This is often related to a lack of general usability engineering methods [12] and specifically to a lack of experience in end-user-centred methods [24]. Design and development, which are only based on the potential of technology and ignore human abilities, are insufficient. Consequently, it is necessary to carefully study which combination of media, device, and application is most advantageous to further increase the quality of end-users' experiences. This must be made at the intersection of psychology and computer science, where HCI and usability engineering traditionally work. The underlying goal is to strengthen interdisciplinary research and development to bring clear benefits and increased value for the end-users.

As far as deaf and hard of hearing (D/HH) end-users are concerned, an emphasis should be placed on universal access for social networking sites (SNSs). The reason lies, on the one hand, in the increasing popularity of using these sites. For instance, the most popular SNS, Facebook, reached 1.1 billion users in 2013 (Der Standard, 2013). This phenomenon has influenced various social groups, also D/HH users, and has spread into various fields, including education [19].

On the other hand, D/HH users have some communication specificities compared with hearing users, such as using not only written or spoken language, but also sign language. For the majority of people born deaf, sign language is their first language and written or spoken language is their second language [22]. This can result in difficulties in reading comprehension and writing, especially on SNSs, where the written word prevails. Using SNSs, the place of their communication has changed, which may affect their communication experiences and preferences. These may be related to the communication context, including identity-relevant factors, such as who they are, who they communicate with, how they like or prefer to communicate and how they feel due to their hearing loss.

Several studies have examined the activities of D/HH online users, including identification with the Deaf and the use of technology [2, 25, 32, 33]. However, there is a lack of research into the preferences and experiences of D/HH users of SNSs. Existing studies have not yet taken into account the preferred mode of communication, whether in sign or written language, on SNSs, in combination with a motivation for communicating, community identifications and stigma associated with hearing loss. The present research aims to fill this gap.

The main purpose of the study presented in this paper is to propose and apply a model to examine the experiences and preferences of D/HH users of SNSs. Within the model, the aim is to examine and clarify how the motivation for communication on SNSs is associated with the above-mentioned aspects. Moreover, the study aims to identify the relationship between reading comprehension skills and feelings of stigmatization due to hearing loss on SNSs.

2 Related work

In existing research, there have been many attempts to examine the activities of D/HH online users. Numerous studies have dealt with how people either develop relationships with information communication technology (ICT) or interact with other people based on ICT practices.

First, much attention has been paid to activities of D/HH online users where technical and socio-psychological aspects were investigated. For instance, Barak and Sadovsky [2] showed in their study that D/HH users were motivated to use the Internet and actually used it more intensively than hearing users for both personal and group communication. Deaf people who were intense Internet users also reported a higher level of well-being than less-intense Internet users. The authors advantageously examined motivations for using the Internet and distinguished between personal and group communications. However, it is disadvantageous to consider the behaviour of D/HH users on the Internet in general and not specifically on SNSs, which constitutes the focus of the research in this study. There has also been a lack of investigations into the subjects of identifying with communities and feelings of stigma.

Trewin et al. [32] mainly explored the technical aspects of D/HH users' online activities. This was done via the example of online gaming, in which the users' motivation to participate depended on augmenting hearing information with textual information. Additionally, they showed that group rather than individual activities were an important aspect of participation rates in online gaming. On the one hand, this is advantageous since D/HH people are considered not only as individuals, but also as members of social groups. On the other hand, the study lacks an examination of users' background, such as the stigmatization that comes from their hearing.

Another study [25] also addressed socio-psychological aspects, where the issue of self-labelling and identification with being Deaf was included. It was shown that Deaf people use a wide range of technology, such as short message services (SMS), telephone typewriters, voice relay services or faxes. Out of these, some technology services, such as SMS, allow Deaf people in contact with hearing people to conceal their identification with being Deaf. Consequently, the authors argued that as the text-based distance relationship was established, it was no longer necessary for the recipient of the message to know about

the sender's deafness. It is advantageous that the authors explored identification with the Deaf in relation to the use of technology. However, the authors did not consider the motivation for communication and how it was related to identification with the Deaf.

Second, interactions between users based on ICT practices were examined by Valentine and Skelton [33]. The authors advantageously reported that the online- and offline world are mutually interdependent and showed how the Internet enlarged the community as a concept and practice. They substantiated that the Deaf space is produced online and compared it to the offline world. However, the authors did not consider the non-technical aspects of the communication activities of D/HH people on SNSs and the questions of stigma due to their hearing loss.

3 Proposed model SocWeb4D

Based on previous research [2, 3, 25, 32, 33] and extending the work by Jambor and Elliot [17], the present study proposes a model "Social Web for the Deaf" (SocWeb4D) that can be used to examine the preferences and experiences of D/HH users of SNSs. As shown in Fig. 1, the model consists of aspects and factors. The following identity-relevant aspects are included:

1. belonging to online Deaf communities,
2. communication affinity and preference on SNSs (sign and/or written language),
3. stigma associated with hearing loss.

In addition to these aspects, the model also suggests considering other factors, such as participants' demographic characteristics, what SNSs D/HH they use, their motivation for communicating, as well as their communication situation, such as language and reading comprehension skills. The interplay of the above-mentioned aspects and factors is of significant importance, since experiences can be shaped through the way of D/HH users' interaction with others and individuals' socio-psychological background.

The model suggests using a questionnaire developed in accordance with aspects and factors, as well as procedures under which the questionnaire can be used, and methods for statistical analysis. To analyse the results, the reliability of the questions should be tested first and a bivariate correlation analysis should follow.

In this study, the term SNS is used in two closely related ways: as a particular website and as a virtual social environment established at this website. To be more precise, the first way of using the term SNS refers to any existing SNS on the Internet that suits the definition by Boyd and Ellison [4] and not just those used exclusively by D/HH people. According to that definition [4], SNSs are considered to be web-based services that allow individuals to construct profiles, articulate a list of users with whom they connect and search within the list of connections. When users create their profiles within the website and connect with other members online, reference is made to the second way of using the term: SNSs as virtual social environments.

In subsequent sections, the inclusion of three aspects in the model is substantiated and a hypothesis within each aspect is provided.

3.1 Belonging to online Deaf communities

A person's sense of belonging within the d/Deaf communities may be reflected in the labels they use for

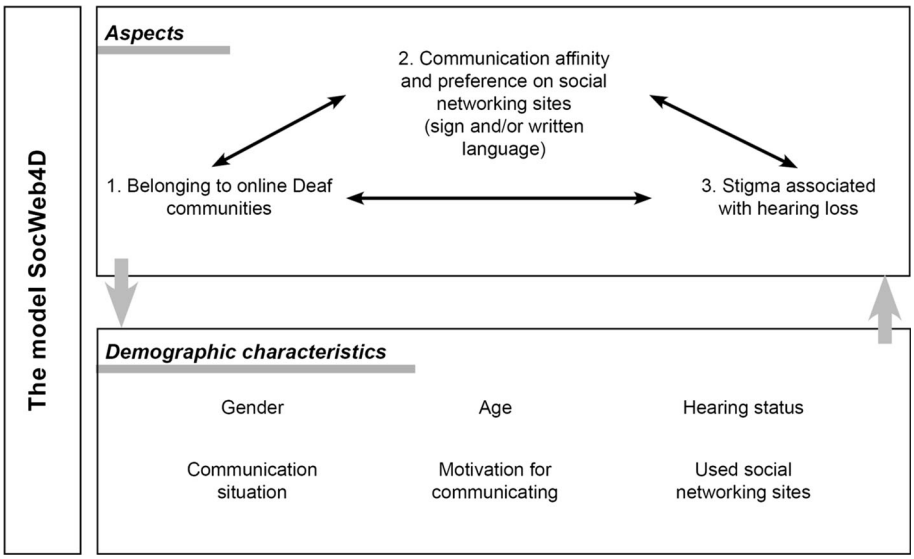

Fig. 1 A graphical scheme of the SocWeb4D model

themselves. Deaf people can identify themselves as deaf (lowercase) when referring to "the audiological condition of not hearing" and as Deaf (uppercase) when referring to "a particular group of deaf people who share a language and a culture" [23] (p. 2). Similar to using self-labels, identification with communities of D/HH people can be performed in at least two different ways. The first group may not associate with other deaf people and they are thus only members of the deaf community (lowercase) due to their hearing loss. The second group includes totally deaf people with sign language as a key means of communication, and may identify with the Deaf community (uppercase), be proud of their membership within the community and be active within it.

In the offline context, identification with communities is reported to have a positive impact on individuals, e.g. higher self-esteem. Deaf people who do not identify with the Deaf community, but rather try to belong to the hearing community, are likely to suffer poor self-esteem [28]. This phenomenon may have an impact on using sign and written or spoken language in various contexts. In an online context, this issue should be studied separately, as the shift from offline face-to-face communication to online communication occurs. Similarly, interactions in online communities are not just recreated offline interactions and do not necessarily result in the same behaviour as in offline communities.

Considering that communication is an important factor in belonging to a specific type of community and establishing an identity online, a motivation for communicating on SNSs may have a positive contribution to identification with online Deaf communities. Such an examination may contribute to the question of universal access, as it can help illustrate how D/HH end-users work, and what their communication specifics are with respect to the social context on SNSs as well as how it can reflect their communication with technology. Thus, the following three hypotheses are tested:

Hypothesis 1 The motivation for communication on SNSs will be positively related to identification with online Deaf communities.

3.2 Communication affinity and preference on SNSs

D/HH people perceive sign and written language differently. To people whose hearing loss dates from birth or from an early age, sign language is in many cases the primary means of communication. Communication in a written language can thus be considered to be a barrier. They can be anxious about composing written messages not only in communication with hearing people, but also within Deaf communities, because of the difficulties in the grammar of written language [11] or the possibility of making spelling mistakes [3, 26]. However, written communication, which prevails on the Web, can be also advantageous for D/HH people. It enables users to conceal their hearing loss and D/deaf identity [2, 33] when communicating with strangers or hearing people online. Thus, the modes of communication D/HH users like to use on SNSs should be examined. The authors propose investigating affinity and preference for modes of communication.

Affinity, on the one hand, reflects users' liking of a particular mode of communication independent of other modes. Preference, on the other hand, designates preferential affinity, where users like a particular mode of communication more than other modes. The proposal is to examine affinity for communication in sign language, affinity for communication in written language and preference for communication in sign language.

The reason is that affinities for both languages are not necessarily exclusive. Affinity for communication in sign language cannot be considered to be the opposite of communication in written language. Hence, the preference for the mode of communication in sign language should also be assessed, emphasising occasions where a feeling of discomfort during writing or reading arises. It can be advantageous to consider enhancing universal access since the understanding of the preferred mode of communication of D/HH users is crucial in providing an appropriate design of the communication tools supporting the online social interaction of these users.

Hypothesis 2 The motivation for communication on SNSs will be positively related to the preference for communication in sign language.

3.3 Stigma associated with hearing loss

Within this aspect, focus will be on the stigma of D/HH users when communicating with users of SNSs; differentiating between situations where they are familiar with the recipient's hearing status (D/HH or hearing) and those where they are unfamiliar with it. In these communication situations, interaction problems can emerge, resulting in the concealment of a disability [29]. Luetke-Stahlman [21] gives, as an example, minimal interactions among hearing adolescents and those who are D/HH; whereas close relationships among them are also rare. When hearing and D/HH persons are faced with interaction problems, usually the D/HH person is the one who is stigmatized [20]. The reason can lie in the D/HH person's efforts to conceal their hearing loss [18].

Stigma may appear in online communication due to the mode of communication of D/HH users. Although prevalent written communication enables users to conceal a disability and contributes to lower levels of perceived stigma [6, 8], disabled persons can feel inconvenient when

communicating online. A previous study [9] showed that disabled users observe a change in the recipients' behaviour when they are made aware of the sender's disability. In the following hypothesis, the stigma of D/HH users in situations when they communicate with written language will be examined. This can be advantageous for universal access since the findings of investigating feelings of stigma can contribute to a better understanding of the communication process of D/HH users.

Hypothesis 3 Reading comprehension skills on SNSs will be negatively related to feelings of stigma associated with hearing loss.

4 Methods

4.1 Participants

The sample for this study was recruited from the D/HH population in Slovenia. Specifically, 59 D/HH persons were invited to participate, but only the users of SNSs (46 participants) were included in the study. Out of these, 30 were male and 16 were female. The mean age was 30.35 (age range 15–67, SD = 13.11). Twenty-six participants (56.5 %) were deaf and 20 (43.5 %) were hard of hearing. Descriptive statistics in Table 1 show the basic characteristics of the participants. Most of them were skilled sign language users and the majority reported good or very good sign language skills and reading comprehension skills. The majority used Facebook.

Table 1 Basic characteristics of the sample population

Characteristics	*n*	%
Sign language skills		
Very poor	2	4.30
Poor	–	–
Undecided	5	10.90
Good	17	37.00
Very good	22	47.80
Reading comprehension skills		
Very poor	–	–
Poor	4	8.70
Undecided	8	17.40
Good	21	45.70
Very good	13	28.30
Motivation for communicating in SNSs		
Totally unmotivated	2	4.30
Unmotivated	1	2.12
Undecided	12	26.10
Motivated	16	34.80
Totally motivated	15	32.60
Users of SNSs		
Total number	46	100.00
Facebook	41	93.50
Google +	25	54.30
Oovoo	19	41.30
Camfrog	22	47.80
Netlog	12	26.10
Myspace	4	8.70
LinkedIn	2	4.30

4.2 Measures

A questionnaire was used comprising four sections: (1) demographic characteristics, (2) belonging to online Deaf communities, (3) communication preference and affinity for communication on SNSs and (4) the stigma of D/HH users.

The first section contained information about gender, age, hearing status, the communication situation (user's opinions on their own communication skills in sign language and reading comprehension skills), motivation for communicating on SNSs and a list of the most regularly used SNSs. Hearing status was defined according to the American National Standards Institute [1]. This defines people with an unaided hearing loss of 91 dB or greater as deaf, and those with an unaided hearing loss between 27 and 91 dB as hard of hearing.

The second section recorded belonging to online Deaf communities. It was measured by a part of the questionnaire for assessing group identification [17]. Two five-point Likert-type scale items with response categories ranging from 1 (strongly disagree) to 5 (strongly agree) were included and expanded, so that measuring identification with offline Deaf communities was adjusted to an online context. A two-item scale was used due to the non-optimal educational situation of D/HH people in Slovenia and its consequences in understanding the language. An item example: "I find it pleasant to be a member of the online Deaf community". The alpha reliability coefficient of the questions was .734.

In the following section, the communication preferences and affinity for the mode of communication on SNSs were measured by the following principles: (a) affinity for communicating in sign language, (b) affinity for communicating in written language and (c) a preference for communicating in sign language. For each aspect, one five-point Likert-type scale item with response categories ranging from 1 (strongly disagree) to 5 (strongly agree) was used. An item example for preference for communicating in sign language was as follows: "When I communicate with written words on SNSs, I feel uncomfortable, because I would rather communicate in sign language".

Fig. 2 Written question with sign language translation in a transparent video

The last section recorded the levels of stigma associated with hearing loss in SNSs with three five-point Likert-type scale items with response categories ranging from 1 (strongly disagree) to 5 (strongly agree). An item example: "When I communicate on SNSs, I feel equal to others". The alpha reliability coefficient of the questions was .773.

4.3 Procedure

The research took place at five D/HH associations in different places across Slovenia. The questionnaire was completed online in both Slovenian sign and written language. Each question was simultaneously translated into Slovenian sign language in a transparent window of a sign language interpreter (see Fig. 2), where the partially tailored technology of the sign language interpreter module (SLIM) [7] was applied. Thus, an unbiased interpretation of the questions was reached and the same conditions were provided for all participants.

Since the literacy of D/HH persons had been reported as low [10], the language of the questionnaire was simplified to an elementary school level. Before the main study was performed, a pre-test was conducted where the content of the written form of the questionnaire and its comprehension were verified by three deaf, two hard of hearing and three hearing persons.

4.4 Statistical analyses

The internal consistency reliability of a set of items for one variable was inspected with the Cronbach's Alpha coefficient [5]. In this way, it was possible to check how closely related a set of items as a group were and ensure that all grouped items measured the same variable. Statistical associations between the variables of all three aspects and other relevant data from demographic characteristics in the study were inspected with a correlation analysis. With respect to the small sample size and ordinal scale level of data, nonparametric correlations (Spearman's Rho) were computed. Variables were set according to the proposed hypotheses. Statistically significant differences between independent samples, regarding hearing loss and gender, were verified by the Mann–Whitney U Test [16]. All analyses were conducted using SPSS version 20.0 software.

5 Results

Bivariate correlations between variables for belonging to online Deaf communities, communication preferences on SNSs and the level of stigma felt due to hearing loss are shown in Table 2.

Within the first hypothesis, the relationship between the motivation for communicating on SSNs and identification with online Deaf communities was tested. As shown in Table 2, a positive statistically significant relationship was found between the motivation to communicate and belonging to the online Deaf communities. It indicates that an increased motivation for communicating was related to increased identification with online Deaf communities. Belonging to online Deaf communities was also statistically significantly related to sign language skills and affinity for communicating in sign language.

The second hypothesis was confirmed due to a statistically significant and positive relationship between the motivation for communicating and the preference for communicating in sign language. The result indicates that, as motivation to communicate increases, the preference for communicating in sign language also increases. The users differed regarding their hearing loss and preference for communicating in sign language. Mann–Whitney U test showed a statistically significant difference between D/HH users and their preference for communicating in sign language rather than in written language (the mean ranks of the D/HH are 27.02 and 18.93, respectively; $U = 168.5$,

Table 2 Correlations between the variables

	1	2	3	4	5	6	7	8
(1) Motivation for communicating on SNSs	1.000	.336*	.052	.469**	.505**	.330*	.344*	−.121
(2) Sign language skills		1.000	.273	.505***	.291*	.220	.013	−.312*
(3) Reading comprehension skills			1.000	.079	−.186	.171	−.285	−.532***
(4) Belonging to online Deaf communities				1.000	.458**	.437**	.184	−.104
(5) Affinity for communicating in sign language on SNSs					1.000	.171	.420**	.137
(6) Affinity for communicating in written language on SNSs						1.000	−.022	−.113
(7) Preference for communicating in sign language on SNSs							1.000	.434**
(8) Stigma on SNSs								1.000

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$

$p < .05$). The results indicated that the deaf prefer communicating in sign language (median = 3.23, SD = 1.48) on SNSs more than hard of hearing users (median = 2.35, SD = 1.14). The motivation to communicate was further significantly positively associated with an affinity for communicating in written language.

To test the third hypothesis, the relationship between the stigma associated with hearing loss on SNSs and reading comprehension skills was analysed. The results showed a negative relationship between the level of stigma felt and reading comprehension skills. It indicates that, as reading comprehension skills improve, the level of stigma decreases. In addition, a positive statistically significant association was found between the preference for communicating in sign language and stigma. The result indicates that as the preference for communicating in sign language increases, the stigma also increases.

Statistically significant differences were also found between male and female users in their affinity for communicating in sign language. Women like communicating in sign language (median = 4.38, SD = .81) more than men do (median = 3.47, SD = 1.38), $p < .05$.

6 Discussion

The primary objective of this study was to illustrate how to enhance universal access for D/HH users on the example of utilising SNSs. The aim was to propose and apply a model examining the experiences and preferences of D/HH users of SNSs SocWeb4D from the aspect of belonging to online Deaf communities, communication affinity/preferences for sign and/or written language, and the stigma associated with hearing loss. Three predictions were defined at the beginning of the study.

First, a statistically significant relationship between the motivation to communicate on SNSs and identification with online Deaf communities was predicted. This hypothesis can be confirmed since the results have shown that the motivation to communicate on SNSs was significantly associated with belonging to online Deaf communities. Hearing loss could not be substantiated as a reason, because there were no differences found between the groups of D/HH users.

The motivation for communicating was also positively associated with an affinity for sign language and written language, as well as with the preference for communicating in sign language. Secondly, the findings confirmed the hypothesis that predicted a statistically significant relationship between two variables: (a) the motivation for communicating and (b) the preference for communicating in sign language. A positive statistical relationship indicated that as the preference for communicating in sign language increased, the motivation for communication also increased. A reasonable way to explain this result is that the use of sign language, rather than written language, motivates D/HH users to communicate on SNSs. Intriguingly, the deaf prefer to communicate in sign language slightly more than hard of hearing users.

The research findings also confirmed the third hypothesis, which predicted a statistically significant negative relationship between feeling stigma due to hearing loss and reading comprehension skills. The results demonstrated that improvement of reading comprehension skills was closely related to decrease in feelings of stigma and may have had an impact on D/HH users' communications in written language on SNSs. An adequate explanation for this finding can be found in the fact that D/HH users perceive written communication as a barrier and thus fear composing written messages [3, 26].

The findings of this study are in alignment with the results of Jambor and Elliot [17], when they provided evidence that identification with the deaf is positively related to self-esteem. In the present study, it was substantiated that identification with online Deaf communities is positively associated with the motivation to communicate on SNSs; as well as an affinity for communicating in sign and written language. Thus, it can be concluded that

both the facts how one likes to communicate in sign language on SNSs and how he/she is skilled in the same language play an important role when it comes to identifying with online Deaf communities and furthermore with regard to motivation when communicating on SNSs.

Additionally, the research findings complement the results of previous studies [6, 8], which showed that the prevalence of written communication can mask impairments and thus contribute to feelings of being less stigmatized. Similarly, the results of this study have shown that low reading comprehension skills indicate more feelings of being stigmatized due to hearing loss.

The proposed SocWeb4D model can be used in educational purposes since it comprehensively recognises the needs of D/HH users of SNSs. Communication issues included in the model can be important in enhancing universal access for D/HH users. For instance, investigating online collaborative learning for this group of users, where social interaction is a crucial element and SNSs are being implemented as communication tools into online Personal Learning Environments (PLE) [19]. As the model presented relates to D/HH users of SNSs, the findings may help improve implementation of these tools in PLEs to be more accustomed for users with hearing loss, which can be a great advantage for universal access.

To be more precise, such tools enable users to directly send text messages from the PLE to the most relevant peers on SNSs, since these users may not be present in the PLE at the moment, but may be available on SNSs. In the described situation, the results could contribute to improving the design of these communication tools, so that sending messages would be more accessible for D/HH users. The improvements would enable D/HH users to send video messages to their peers and to send messages not only to individuals, but also to a selected group of members of the Deaf community on SNSs at the same time, since the motivation for communication was confirmed to be related to identifying with online Deaf communities.

7 Limitations and future work

One limitation of the study presented is that there is only a relatively small sample of D/HH available in Slovenia, who could thus be included in the study. Firstly, focus was on D/HH members of Slovenian deaf clubs, which may have had an impact on the results, since non-members of traditional deaf clubs were excluded. This may reflect language use and group identification in a way that may not be found in a study where a larger sample included both members and non-members. Secondly, the study is limited in that it examines D/HH people in Slovenia only. The results may vary across countries as sign language and may have a different status in different countries. For instance, in some countries, the right to use sign language is respected more than in other countries. This may be reflected in the aspects examined in this present study, in a way that different results might be found in a study that would include D/HH users of SNSs from various countries.

Another limitation is the lack of a more complete personal background of the D/HH people included in the study, such as data about their family and schooling. The hearing status of participants' parents and preferred mode of communication at home were not examined. Secondly, there was no differentiation between teaching styles used at different Slovenian educational institutions, such as oral/aural, bilingual or total communication, although D/HH people educated following all three teaching styles were included. This may reflect language use and motivation for communication in a way that may not be found in a study where participants were clearly distinguished according to the teaching style used in their educational process.

As far as the study measures are concerned, self-reporting was primarily used, where participants assessed their skills and motivation by themselves. Consequently, it was not possible to know exactly how skilled or motivated the participants really were. This may result in a situation where both skills and motivation are different when they are measured by valid objective measures.

Regarding future work, a subject of research could be the implications of online communication in sign or written language on online community building, where interactions between members of the same online community can be discovered. What is more, it would also be beneficial to not only investigate connections between members of a particular online community, but also between different online communities, in order to understand the experiences and preferences of D/HH individuals within a wider social context.

Acknowledgments The authors would like to thank the Ljubljana School for the Deaf in Slovenia and the Slovenian Deaf and Hard of Hearing Associations for participating in this study. This work was supported by the Slovenian Research Agency [1000-11-310140].

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