What Social Presence is, what it isn’t, and how to measure it:
A work in progress

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Abstract
In educational settings that rely in large part on computer-mediated communication, like online learning and computer-supported collaborative learning, social presence is considered an important aspect of the learning experience. However, because there are many definitions and operationalizations in the literature, there is confusion as to what social presence actually is and how it affects learning in mediated spaces. In this paper, we argue for a clear definition that is rooted in its original conception by Short, Williams, & Christie (1976) emphasizing ‘realness’ of the other in the interaction. We present a social presence scale using Rasch analyses to validate the scale. Our findings are that this scale measures well those who have high perceptions of the ‘realness’ of the other whereas this is moderate for those who have only low perceptions of this ‘realness.’ Further improvement of the scale is, therefore, necessary.

Keywords: Social Presence, CSCL, Online Learning, Rasch Measurement Model, Rasch Analysis, Social Interaction

Introduction
In 1976, Short, Williams, and Christie coined the term social presence, defining it as “the degree of salience of the other person in the communication and the consequent salience of the interpersonal relationships” (p.65). In educational settings that rely in large part on computer-mediated communication (CMC), like online learning and computer-supported collaborative learning, social presence is considered an important aspect of the learning experience. This is because, unlike face-to-face communication, CMC usually conveys little socio-emotional cues. This is especially true for text-based asynchronous communication (e.g. message boards), that are still a large part of the educational technology landscape, for example in learning management systems. In order to understand what makes CMC effective for students, social presence has become an important variable to consider. Researchers have linked social presence to important outcome variables of online learning, e.g. satisfaction and perceived learning (Gunawardena & Zittle, 1997; Richardson & Swan, 2003; Richardson, Maeda, Lv, & Caskurlu, 2017), online course retention (Liu, Gomez, & Yen, 2009) and online social interaction (Tu & McIsaac, 2002). In addition to this, social presence has a prominent role in the community of inquiry (COI) framework, alongside teaching presence and cognitive presence (Garrison, Anderson, & Archer, 2000; 2010). However, important issues regarding definition and measurement of social presence remain (Kreijns, Jochems, & Van Buuren, 2011; Kreijns, Van Acker, Vermeulen, Van Buuren, 2014; Weidlich & Bastiaens, 2017; Lowenthal & Snelson, 2017; Öztok & Kehrwald, 2017). These may even call into doubt some of its purported effects.

Convoluted Definitions
When considering research on social presence, one is confronted with a plethora of different definitions and, consequently, operationalizations of social presence. This may be, in part, because social presence theory stems from a rather diverse line of research (Cui, Lockee, & Meng, 2013). Yet, it is a problem for cumulative science if researchers lack a clear and consistent way of talking about a phenomenon. Lowenthal’s Continuum (2010) illustrates this lack of clarity and consistency. He argues that even though most scholars will attribute their understanding of social presence to the concept proposed by Short et al. (1976) “[d]efinitions of social presence,
at least for researchers of social presence and online learning, tend to fall on a continuum” (p. 120). The continuum reaches from social presence as the salience of the other person in the interaction - whether someone is perceived as being “present” and “real” - to social presence as the salience of the interpersonal relationships, including whether or not there is an interpersonal emotional connection. Because most researchers tend to fall somewhere in the middle of this continuum (Lowenthal, 2010), many definitions of social presence are not only different from each other but also convoluted. That is, they lack clear analytic boundaries, that allow differentiating social presence from other related variables.

For illustration, consider operational definitions in these three classical social presence papers. For Rourke, Anderson, Garrison, and Archer (2000), social presence is “the ability of learners to project themselves socially and affectively into a community of inquiry” (p.50). For Tu & McIsaac (2002), it is a “measure of the feeling of community that a learner experiences in an online learning environment” (p.131). Gunawardena & Zittle (1997) stay closer to Short et al.’s (1976) original proposition by defining it as “the degree to which a person is perceived as a ‘real person’ in mediated communication” (p.9). one might think that these three definitions refer to different phenomena. Yet, they are all called social presence. For a more in-depth discussion on how social presence has been defined by different researchers, see Lowenthal & Snelson (2017).

Of course, these issues of definition will affect attempts at measuring social presence. There has been very little consistency, yet great quantity in the way researchers have measured social presence. For example, Rourke, Anderson, Garrison, & Archer (2001) established twelve indicators to analyze online discussions in terms of demonstrated social presence. As such, it is a behavioral measure. More recently, a COI survey instrument was developed (Arbaugh, Cleveland-Ines, & Diaz, 2008) and validated (Diaz, Swan, Ice, & Kupezyński, 2010; Carlon, Bennett-Woods, & Berg, 2012). Outside of the COI framework, other social presence surveys - old and new - are abundant. Gunawardena (1995), Gunawardena & Zittle (1997), Tu (2000), Picciano (2002), Wei, Chen, & Kinshuk (2012), Kim (2010) and Kim, Kwon, & Cho (2011) all developed different questionnaires to assess social presence. Because these measures are based on convoluted definitions of social presence, they too may be convoluted. Indeed, Kreijns, Kirschner, Jochems, & Van Buuren (2011) and Kreijns et al. (2014) show that many of these measures do not exclusively measure social presence, but instead “measure varying aspects of an amorphous set of variables – including social presence, to varying degrees” (p.371).

Correlates of Social Presence
In order to reach a clearer understanding of how social presence may emerge and in which ways it may affect learning processes in online environments, it is important to untangle social presence from its correlates. In other words, to clearly define what it is and what it isn’t. Although many scholars hold that social presence is multidimensional and multi-faceted (see chapter “uni-dimensional definition” below), we are skeptical of this proposition. The following sections will review concepts that are associated, and some of them conflated, with social presence. Because experimental evidence in social presence research is still rare, the causality of these correlates is not always readily established. Wherever possible, either based on theoretical grounds or preliminary data, the hypothesized causal relationship will be indicated.

Student-Student Interaction or Social Interaction: Many researchers have mentioned the close relationship between social interaction and social presence. For example, Tu & McIsaac (2002) assert that social presence will increase social interaction and Wei et al. (2012) propose a model in which social presence is a predictor variable for social interaction. In contrast, Kim et al (2011) determine social interaction (or interactivity, as it is referred to in their study) as a predictor for social presence in the regression model. Differently again, Biocca et al (2003) state, that social presence is the theory of mediated interaction and therefore includes the concept of interaction. However, there is no support for the notion that social interaction is in any way an aspect or dimension of social presence. Because they are defined differently and have been shown to be empirically related, yet distinguishable (Kim, Song, & Luo, 2016; Weidlich & Bastiaens, 2017), there is no reason to conflate these two variables.

Regarding causality, arguments can be made for social interaction as predictor as well as a dependent variable. A predictor, because social interaction is a necessary first step in getting acquainted with and forming an impression of a communication partner. A dependent variable, because a higher degree of social presence may make mediated social interaction feel less artificial and, thus, more likely. Also, because communication in social systems is complex, a bidirectional view of social interaction and social presence influencing and reinforcing each other may be the most accurate portrayal of this relationship (Kreijns et al., 2013).

Cohesion, Climate, and Community: When talking about social presence, many researchers actually seem to talk about aspects relating to group cohesion, learning climate, and/or sense of community. This is clear when looking at the way they define and operationalize social presence, as it is common to include these aspects either implicitly or explicitly. This is also the case in the arguably most prominent appropriation of social presence, the Community of Inquiry framework. For example, Garrison (2009) defines it as “the ability of participants to identify with the community (e.g. course or study), communicate purposefully in a trusting environment, and develop
interpersonal relationships by way of projecting their individual personalities” (p.352). Clearly, group cohesion, learning climate, and sense of community are dominant in this definition, with “the degree of salience of the other person in the communication” (Short et al. 1976) going largely unmentioned.

This conflating of rather different concepts and variables under the guise of social presence has been criticized extensively and ways forward have been proposed (Kreijns et al. 2014; Lowenthal & Snellson, 2017; Öztok & Kehrwald, 2017; Weidlich & Bastiaens, 2017). For example, Kreijns et al. (2004) and Kreijns et al. (2014) introduce the concept of social space, the extent to which salient interpersonal relationships among students in the learning environment emerge. As such, it includes aspect of cohesion, climate, and community while being true to the second part of the Short et al. (1976) definition, “the consequent salience of the interpersonal relationships”.

In terms of causality, it is expected that social presence is a prerequisite for the development of a sound social space. This has also been empirically validated by Weidlich & Bastiaens (2017). In addition, it is likely that a sound social space will, in turn, reinforce social presence, which again implies a possible bidirectional relationship.

**Satisfaction & Perceived Learning:** A recent Meta-Analysis by Richardson, Maeda, Lv, and Caskurlu (2017) demonstrated moderately average correlations of social presence with satisfaction ($r=0.56$) and social presence with perceived learning ($r=0.51$). Yet, some of the included studies measure social presence based on a Community of Inquiry questionnaire, which is based on a convoluted definition of social presence. Other studies in this meta-analysis are based on the original Gunawardena & Zittle (1997) and adapted Richardson & Swan (2003) operationalization of social presence. A look at the items of these measures confirms that they, too, measure aspects of community to some extent, e.g. “The moderators created a sense of online community” (Gunawardena & Zittle, 1997, p. 15) and “this activity allowed me to form a sense of online community” (Richardson & Swan, 2003, p.68).

Because these studies either implicitly or explicitly measure more than perceptions of social presence, the actual relationship of social presence to important outcome variables like satisfaction and perceived learning is not as clear as the meta-analysis would imply. In addition, some items of these social presence measures actually seem to tap satisfaction implicitly (“The quality of learning for this activity was excellent”, Richardson & Swan, 2003), making inference on this relationship somewhat of a tautology.

At this time, there is a scarcity of studies that assess the relationship of these subjective outcome variables with a precisely defined social presence. Although a seemingly large amount of research has been conducted on the assessment of these relationships, many more studies actually are necessary. In one instance, Weidlich & Bastiaens (2017), using the Kreijns et al. (2011) measure, demonstrated no relationship of social presence with satisfaction, yet a small but significant one with perceived learning.

Regarding causality, if there is a relationship, it is intuitive that social presence will be a predictor for these outcomes variables, but is questionable whether they will retrospectively influence the amount of social presence perceived during learning.

**Achievement:** Although scholars champion the importance of social presence for online learning and CSCL, there is still little evidence for an effect of social presence on actual learning achievement. The line of research concerned with the Community of Inquiry Framework proposes that the presences “can enhance or inhibit the quality of the educational experience and learning outcomes” (Garrison et al., 2000, p.92). Yet, most studies within this framework or on the subject of social presence specifically do not assess actual measures of cognitive learning or achievement. Instead they use self-report measures of satisfaction or perceived learning, which may be interesting in its own right (Richardson, Maeda, & Swan, 2010), but surely isn’t the same as an objective measure. A recent study using the Community of Inquiry survey found no evidence for a relationship of social presence (and the other presences) with any of three instructor-assessed measures of learning achievement (Maddrell, Morrison, & Watson, 2017). Another study used the behavioral indicators of Rourke, Anderson, & Archer (2001) to examine which of them had predictive capabilities for the final grade (Joksimovic, Gasevic, Kovanovic, Riecke, & Hatala, 2015). They found that some of them did, with “continuing a thread” and “complimenting, expressing appreciation” explaining 16% of the variance in the final grade. In a similar vein, a study by Hostetter (2013) found that social presence measured via a compound variable of the aforementioned indicators and the Richardson & Swan (2003) survey scored higher in an objective measure of learning.

Although Joksimovic et al. (2015) and Hostetter (2013) seem to provide preliminary evidence pointing to a relationship between social presence and achievement, it should be noted that their measures are not based on a precisely defined social presence and instead include other variables, via the Richardson & Swan (2003) survey and e.g. the indicator “complimenting, expressing appreciation”. As of now, we are not aware of any research that has successfully linked a precisely defined concept of social presence with an objective measure of learning.

In terms of causality, achievement is expected to be a dependent variable. Similar to satisfaction & perceived learning, social presence is seen as a causal factor, expected to explain differences in learning processes.
A New Measure for Social Presence

Because the literature is rife with convoluted definitions of social presence and problematic measures, we propose an alternative measure of social presence. It is based on a uni-dimensional definition of social presence that emphasizes ‘realness’ of the other in the interaction. Unlike previous social presence measures, it is based on the Rasch Measurement Model.

**Rasch Measurement Model:** Rasch Analysis is a psychometric approach to the development of tests and measures (Rasch, 1960). Rasch techniques allow to assess and document the measurement functioning of items within a measure (such as determining their level of difficulty; their fit with the Rasch Measurement Model) while at the same time doing the same for the respondents (such as determining their ability to endorse items; their fit with the Rasch Measurement Model). Through this, strengths and weaknesses of the test or instrument may be assessed systematically and the measure can be modified accordingly in an iterative process, leading to a measure with strong psychometric properties. It overcomes many of the weaknesses of Classical Test Theory, the still dominant paradigm of scale development (see for example Smith, Conrad, Chang, & Piazza, 2002).

One important requirement of the Rasch Measurement Model is unidimensionality of the construct. Based on our understanding of social presence, this requirement is met and, thus, Rasch Analysis an adequate approach.

**Table 1: Social Presence Measure**

<table>
<thead>
<tr>
<th>Nr</th>
<th>Item</th>
<th>7 rating scale steps</th>
<th>5 rating scale steps</th>
<th>N*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>In this learning environment …</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP01</td>
<td>… it feels as if we are a face to face group</td>
<td>2.93</td>
<td>1.47</td>
<td>39.30</td>
</tr>
<tr>
<td>SP02</td>
<td>… it feels as if I cannot escape from the eyes of my fellow students</td>
<td>2.08</td>
<td>1.18</td>
<td>1.75</td>
</tr>
<tr>
<td>SP03</td>
<td>… it feels as if I deal with ‘real’ persons and not with abstract anonymous persons</td>
<td>4.12</td>
<td>1.70</td>
<td>33.37</td>
</tr>
<tr>
<td>SP04</td>
<td>… I feel to be together with my fellow group students</td>
<td>3.22</td>
<td>1.51</td>
<td>2.38</td>
</tr>
<tr>
<td>SP05</td>
<td>… I can form distinct impressions of some of my fellow students</td>
<td>3.66</td>
<td>1.51</td>
<td>35.90</td>
</tr>
<tr>
<td>SP06</td>
<td>… it feels as if all my fellow students are 'real' physical persons</td>
<td>4.42</td>
<td>1.69</td>
<td>31.76</td>
</tr>
<tr>
<td>SP07</td>
<td>… I imagine that I really can 'see' my fellow students to be in front of me</td>
<td>2.98</td>
<td>1.56</td>
<td>39.04</td>
</tr>
<tr>
<td>SP08</td>
<td>… my fellow students feel so 'real' that I almost believe that we are not virtual at all</td>
<td>3.01</td>
<td>1.62</td>
<td>38.91</td>
</tr>
<tr>
<td>SP09</td>
<td>… I have my fellow group members in my minds’ eye</td>
<td>3.09</td>
<td>1.70</td>
<td>2.30</td>
</tr>
<tr>
<td>SP10</td>
<td>… all of my fellow students imagine that they really can 'see' me to be in front of them</td>
<td>2.82</td>
<td>1.46</td>
<td>2.17</td>
</tr>
<tr>
<td>SP11</td>
<td>… all of my fellow students feel that I am a 'real' physical person</td>
<td>3.60</td>
<td>1.70</td>
<td>35.94</td>
</tr>
<tr>
<td>SP12</td>
<td>… it feels as if all my fellow students and I are in the same room</td>
<td>2.77</td>
<td>1.55</td>
<td>40.11</td>
</tr>
<tr>
<td>SP13</td>
<td>… it feels as if I can really 'touch' my fellow students</td>
<td>1.86</td>
<td>1.12</td>
<td>1.61</td>
</tr>
<tr>
<td>SP14</td>
<td>… it feels as if all my fellow students and I are in close proximity</td>
<td>2.45</td>
<td>1.48</td>
<td>41.80</td>
</tr>
<tr>
<td>SP15</td>
<td>… I strongly feel the presence of my fellow students</td>
<td>3.09</td>
<td>1.68</td>
<td>38.54</td>
</tr>
<tr>
<td>SP16</td>
<td>… all of my fellow students feel my presence</td>
<td>2.78</td>
<td>1.53</td>
<td>2.15</td>
</tr>
</tbody>
</table>

* N is calculated by taking the total number of respondents (=324) and subtracting 1) respondents who did not answer this item, 2) respondents who had a misfitting answer on this item — the misfitting answer was marked as missing, and 3) respondents who completely misfit the Rasch Measurement Model (Nmisfit = 20).
**Uni-dimensional Definition:** We define social presence as the psychological phenomenon that the other is perceived as ‘real’ in the communication, the subjective feeling of being with other salient social actors in a technologically mediated space. In other words, “the sense of ‘being there, together’, when ‘being there’ does not involve a physical presence” (Öztok & Kehrwald, 2017, p.5). This is based on the first part of the original definition of Short et al. (1976). Accordingly, items that assess social presence should all tap this realness aspect and none of the items should tap correlates of social presence like social interaction, group cohesion, learning climate, sense of community, or satisfaction.

Kreijns et al. (2011) presented a social presence measure addressing the realness of the other in the communication. In this measure, a distinction was made between a synchronous and an asynchronous communication setting. We now believe this distinction should not have been made because it limited the applicability of the measure, as some learning contexts may not include synchronous communication setting or vice versa. In addition, this distinction violates the invariance assumption necessary for Rasch Analysis. Finally, the small number of items in this measure may point to a potential underrepresentation of the social presence construct (Messick, 1996). This makes necessary a new and improved social presence measure that is based on a precise definition and demonstrates sound psychometric properties.

Regarding the uni-dimensionality aspect, we deviate from many other social presence researchers who argue that social presence is a multidimensional construct. For example, Tu (2002a, 2002b) saw as dimensions of social presence 1) social context, 2) online communication, 3) interactivity, 4) system privacy, and 5) feelings of privacy. However, he actually identified these dimensions as variables affecting the degree of social presence. Wei, Chen, and Kinshuk (2012) saw as dimensions of social presence, 1) co-presence, 2) intimacy, and 3) immediacy. These two latter dimensions were also put forward by Short, Williams, and Christie (1976) as we have seen above, but Short, Williams, and Christie declared social presence to be a factor contributing the level of intimacy and enabling immediacy.

We, thus, conclude that many social presence measures exist in the literature sometimes incorporating correlates and/or antecedents of social presence as if they are dimensions of it. Therefore, we decide to consider social presence as a unidimensional construct. As result, a 16-item raw social presence measure was constructed using ordered categorical polytomous ratings: each item has seven rating scale steps (1 = totally disagree, 2 = disagree, 3 = somewhat disagree, 4 neither disagree or agree, 5 = somewhat agree, 6 = agree, 7 = totally agree). Table 1 depicts the social presence measure. In this table, items that were found not fitting the Rasch Measurement Model are greyed, hence they are not part of our social presence measure. The mean $M$ and standard deviation $SD$ are given for the original 7 rating scale step measure and the collapsed 5 rating scale steps measure. Please refer to the analysis section for the modification steps of scale development.

**Method**

**Sample:** Respondents were 324 students at the largest distance university in Germany, FernUniversität in Hagen. This convenience sample consists of students enrolled in either B.Sc. Psychology or B.A. Educational Science. Table 2 shows the demographics for this sample. There was a total of 241 students enrolled in Educational Science, 71 in Psychology, spread over three semesters: winter semester of 2015/2016, winter semester of 2016/2017, and summer semester of 2017. Of these students, 260 were female, 55 were male. Mean age was 32.3 years. Please note that due to missing values, numbers may not add up to total N.

<table>
<thead>
<tr>
<th></th>
<th>Educational Science, B.A.</th>
<th>Psychology B.Sc.</th>
<th>Female</th>
<th>Male</th>
<th>$M_{age}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>WS 15/16</td>
<td>134</td>
<td>99</td>
<td>34</td>
<td>100</td>
<td>26</td>
</tr>
<tr>
<td>WS 16/17</td>
<td>112</td>
<td>92</td>
<td>19</td>
<td>99</td>
<td>12</td>
</tr>
<tr>
<td>SS 17</td>
<td>78</td>
<td>50</td>
<td>18</td>
<td>61</td>
<td>17</td>
</tr>
<tr>
<td>Total</td>
<td>324</td>
<td>241</td>
<td>71</td>
<td>260</td>
<td>55</td>
</tr>
</tbody>
</table>

**Procedure:** Students were recruited for the survey through the learning management system Moodle, in which most learning activities took place. Nearing the end of each semester, they were asked to participate in the survey with no course credit or reward attached to participation. For a duration of two weeks, a link in the learning environment directed them to the survey, which was created via LimeSurvey (http://www.limesurvey.org). The 16 items of the raw social presence were only a small part of a larger survey concerned with student’s perceptions and experiences in the learning environment. Students were informed that the questions are concerned with their subjective experiences and preferences and were asked to answer accordingly. The survey took them a total of about 15 minutes to complete. It was administered over the course of three semesters, as mentioned earlier.
Rasch Analysis: Rasch analyses were performed on all 16 items of the raw social presence measure (see Bond & Fox, 2015 and Boone, 2016 for the procedure). All misfitting items and respondents were removed (the 6 removed items are greyed in Table 1). Furthermore, the rating steps 3 and 4 as well as the rating steps 5 and 6 were collapsed in order to get proper probability curves required by the Rasch Measurement Model. In other words, it appeared that seven rating scale steps were causing some confusion in the respondents to select the right step suggesting the use of five rating scale steps (see Figure 1 and 2).

\[\text{Figure 1: Probabilities of the seven rating scale steps.}\]

\[\text{Figure 2: Probabilities of the five rating scale steps.}\]

Results

In Figure 3, two Wright maps (Wright & Masters, 1982) are shown in which the relative difficulty levels of the items are placed next to the relative ability levels of the respondents to endorse items. That is, the left Wright map shows these difficulty levels when looking at the rating scale steps per item, whereas the right Wright map shows these levels when looking at the items themselves; thus, the Wright map at the right is a summary of the Wright map at the left. Therefore, the current social presence measure is moderate in differentiating respondents with low perceptions of the realism of the other whereas it can excellently differentiate persons with high perceptions of the realism of the other. This indicates that there is some underrepresentation of the construct (Messick, 1996) which would undermine the statistical validity (i.e., the reliability) of the social presence measure (Baghaei, 2008). Nevertheless, item and person separation indices were very good (Boone, Staever, & Yale, 2014, p. 231): item separation index was 10.01 (should be at least 2.5 for the analysis of groups) and person separation index was 3.01 in case minimum extreme persons were included (should be at least 3.0 to represent an excellent level of separation). Classical test theory Cronbach’s alpha was .93.
Conclusions

In this paper we’ve outlined problems surrounding research on the concept of social presence. We conclude that there are many different conceptions of social presence in the literature and most of them are convoluted to some extent. That is, they include other related variables as if they were a part of, or dimension of social presence. Because every conception is different, the effect of social presence on outcome variables is not as unambiguous as the literature might suggest.

We believe that a precisely defined construct that is measured in a psychometrically sound way is the necessary groundwork for cumulative research on social presence. Therefore, we presented a work in progress on an alternative social presence measure. It is based on a precise and unidimensional definition of social presence and developed through Rasch Measurement Model. Our analysis lead to a preliminary 10-item measure showing solid psychometric properties that may be used to assess social presence. However, because our analysis suggests that the construct of social presence isn’t yet fully represented in our measure, it is still a work in progress.
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