Pathway to presence: an investigation of ambient awareness in online learning environments

Joshua Weidlich & Theo J. Bastiaens

To cite this article: Joshua Weidlich & Theo J. Bastiaens (2019): Pathway to presence: an investigation of ambient awareness in online learning environments, Interactive Learning Environments, DOI: 10.1080/10494820.2019.1651746

To link to this article: https://doi.org/10.1080/10494820.2019.1651746

Published online: 04 Sep 2019.
Pathway to presence: an investigation of ambient awareness in online learning environments

Joshua Weidlich a, b and Theo J. Bastiaens c

a Instructional Technology & Media, FernUniversität in Hagen, Hagen, Germany; b Technology-Enhanced Learning, Heidelberg University of Education, Heidelberg, Germany; c Educational Technology, Open University Heerlen, Heerlen, Netherlands

ABSTRACT
Due to the pervasiveness of online technology, especially social media and social networking sites (SNS) like Twitter and Facebook we are surrounded by a constant stream of information about other individuals. On the other hand, even though distance and online learning has become mainstream, there are still concerns leveled at many of these educational offerings, one of them being the relative social isolation of online and distance students. In this study, we investigate if and how ambient awareness, a concept originated in research in interpersonal effects of SNS, can play an important role in how salient social impressions of peers emerge and how this leads to perceptions of social presence among students. To this end, we use an impression formation paradigm in a four-week online distance course (N = 51). We found that students were able to form impressions of their peers through ambient awareness. These impressions differed in prevalence from the ones gathered through direct social interaction. In a larger second sample (N = 169), we find ambient awareness to be a mediator between the sociability of the learning environment and perceptions of social presence. Implications, limitations and suggestions for further research are discussed.

ARTICLE HISTORY
Received 27 February 2019
Accepted 11 July 2019

KEYWORDS
Ambient awareness; impression formation; social presence; online learning; distance education; SIPS

1. Introduction
Online technology, especially social media and social networking sites (SNS) like Twitter and Facebook, provide us with a continual stream of information about other individuals. Through this, we have an unprecedented amount of insight into behaviors and perceptions of other social actors in our network. Even by simply browsing social media and SNS, a non-directed behavior, we are confronted with this plethora of information.

Even though distance and online learning has become mainstream (Seaman, Allen, & Seaman, 2018), there are still concerns leveled at many of these educational offerings, one of them being the relative social isolation of online and distance students (Boling, Hough, Krinsky, Saleem, & Stevens, 2012; Rovai & Wighting, 2005; Stürmer, Ihme, Fisseler, Sonnenberg, & Barbarino, 2018; Symeonides & Childs, 2015). How to help students feel psychologically close, whilst being physically distant, is a long-standing research agenda in distance and online learning, with seasoned and prominent concepts capturing the notion of psychological distance, like social presence (Gunawardena & Zittle, 1997). Despite advances in our understanding of the social realm in mediated learning contexts, many questions still remain. For example, what are the mechanisms of how important socio-emotional
variables emerge and how can they be fostered to improve educational offerings in the socio-emotional realm? One fruitful but not yet well-trodden path may be to leverage our understanding of the psychology of social technology like social media and SNS and to use this knowledge base to better understand and ultimately improve socio-emotional aspects of online and distance learning.

This study investigates if and how ambient awareness, a form of peripheral awareness of others in online environments like SNS, can play an important role in how impressions of other social actors emerge and how this leads to perceptions of social presence among students. Through this, we close an important gap in our understanding about the relevant mechanisms that govern social presence in online distance learning.

2. Theoretical background

2.1. Social presence and the SIPS model

The term social presence goes back to the seminal work of Short, Williams, and Christie (1976) who defined it as “the degree of salience of the other person in the communication and the consequent salience of the interpersonal relationships” (p. 65). Though not the only relevant socio-emotional variable, social presence is by far the most researched concept on how students interact with and relate to others in computer-mediated communication (CMC) and is considered to be an essential factor in online learning (Garrison & Arbaugh, 2007). It is also associated with beneficial variables like satisfaction and perceived learning (Richardson, Maeda, Lv, & Caskurlu, 2017). Its importance stems from the fact that, 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) in learning management systems (LMS) that are still a large part of the online learning landscape (Legon & Garrett, 2018). For this study, we adopt a clear and narrow definition of social presence rooted in the original work of Short et al. (1976), as elaborated in Weidlich, Rajagopal, Kreijns, and Bastiaens (2018): 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).

Building on the work of Kreijns, Kirschner, and Vermeulen (2013), social presence is now embedded in the SIPS model which consists of four central variables: (S) the sociability of the learning environment, (I) social interaction among students, (P) feeling that other students are socially present, (S) leading to a sound social space. The SIPS model has recently been investigated on the structural level (Weidlich & Bastiaens, 2017) and in terms of its central propositions (Weidlich & Bastiaens, 2019). It has also recently been extended by Kreijns and Kirschner (2018).

Perceptions of social presence emerge through a process called impression formation (Walther, 1993). When students form salient impressions of other social actors (i.e. fellow students), for example in terms of personality, appearance, or competence, they may perceive them to be “real” and “there” when communicating in a computer-mediated fashion, thus constituting social presence (Weidlich & Bastiaens, 2017). In its current form, the SIPS model holds that these impressions are formed chiefly through direct social interaction, as this is expected to be the most straightforward way of forming these impressions. However, in learning environments with sufficient identifying information (e.g. profiles) and behavioral traces (e.g. posts, threads, and status updates), it is imaginable that salient impressions of other social actors may form without any kind of direct interaction or even an intention of gathering impressions, merely by browsing the environment and picking up on fragments of information “on the fly”. This mechanism is captured by a recently defined and investigated concept called ambient awareness (Krämer et al., 2017; Leonardi & Meyer, 2015; Levordashka & Utz, 2017). The following two sections will briefly review research on online impressions formation as well as what is currently known about ambient awareness.
2.2. (Online) impression formation

Solomon Asch (1946) is credited with being the first to experimentally study how people form impressions of others. His pioneering work was highly influential in that it not only identified some traits as central in forming impression (vs. peripheral), but also in that his experimental paradigm was used and adopted widely in the following decades. Building on this work, Rosenberg, Nelson, and Vivekananthan (1968) found regularities in people’s judgement of others in that they followed a seemingly underlying structure, organized around the dimensions of “warmth” and “competence”. This was later termed the “Big Two” by Judd, James-Hawkins, Yzerbyt, and Kashima (2005), hinting at the Big Five personality dimensions.

Applying this research into the realm of technological mediation, there is now a large literature investigating how people form impressions through CMC. For example, Hancock and Dunham (2001) found that individuals rated other peoples’ personality profiles differently, depending on if the previously interacted face-to-face or via CMC. More specifically, impressions formed in the CMC condition were less detailed but more intense, suggesting that with less social cues to go on, individuals exaggerated certain attributions. Governing these processes are inferential heuristics (e.g. stereotyping) to generalize from social cues and markers (Fiske & Taylor, 2013).

Similarly, in a widely cited series of studies, Walther (1992, 1993, 1996), found that despite qualitative differences, CMC was not per se less personal or intimate than face-to-face, but instead that communicators adapt to and compensated for the lack of social cues over time. The mechanisms governing these processes were formulated in Social Information Processing Theory (Walther, 1992) and extended with the hyperpersonal model of CMC (Walther, 1996). These and other theories and frameworks are extensively reviewed in Walther (2011).

Moving away from dyadic exchange via CMC, this research tradition has now been applied to the domain of social media and SNS. For example, Van Der Heide, D’Angelo, and Schumaker (2012) showed that textual self-disclosure had a strong impact on impressions of others regarding their social orientation (i.e. introverted vs. extraverted). However, when introducing profile pictures valence in social orientation, these showed a visual primacy effect in that these had a much stronger impression effect, effectively undermining textual self-disclosures. Consistent with the hyperpersonal model, social media users spontaneously generated rich first impressions of others via social media profiles, in a study by Bacev-Giles and Haji (2017). Although profiles were sparse in detail, impressions were favorable, the target being perceived similar and likeable. Consistent with the notion of inferential stereotyping (Fiske & Taylor, 2013), unsubstantiated gender role stereotypes (e.g. male = athletic, female = friendly) were also found.

Taken together, the literature suggests that interpersonal impressions of others in the technologically-mediated realm are governed by attribution processes that are complex and nuanced. Crucially, raters will use all social information available to form impressions of others, when prompted. There seems to be a plethora of interactions and dependencies in how these impressions are formed specifically. Although our understanding has grown substantially, much work needs to be done in order to reach a comprehensive understanding of these processes. Although social presence is a popular idea in research on online learning, impression formation, as an essential aspect of social presence, is hardly ever mentioned. Clearly identifying these relationships empirically constitutes, thus, a gap in research.

As in the investigations reviewed above, it is common in impression formation research to ask participants to judge others (Uleman & Kressel, 2013). Thus, there is an impression formation goal underlying these processes. But what about non-deliberate evaluations that are spontaneous and generated “on the fly”, as would be the case when merely browsing social media? A recently proposed and still sparsely researched concept, we suggest ambient awareness as a powerful driver of interpersonal attributions in online environments.


2.3. Ambient awareness

Ambient Awareness is a peripheral social awareness of others in an online environment, resulting from exposure without direct contact or communication (Levordashka & Utz, 2016). Governed by a process called spontaneous trait inference, there is ample evidence that people spontaneously attribute traits to others based on behavioral traces and personal information (see Uleman, Adil Saribay, & Gonzalez, 2008 for an extensive review). Recently, Levordashka and Utz (2017) have shown that spontaneous trait inferences also take place in social media, where conditions are different than in many experimental paradigms. For example, classic experiments in spontaneous trait inference present one pair of actor and behavior at a time. In contrast, social media displays an array of different social actors and their behaviors in parallel and users browse through this information undirected and often inattentive. It is, thus, not straightforward to assume that distinct impressions form under these conditions. Nevertheless, similar inferential processes were observed in this first investigation by Levordashka and Utz (2017).

Ambient Awareness is a special type of spontaneous trait inference in that impressions are formed spontaneously and goal-free, as well as without direct interaction. It is the sense of knowing the other through posts, statements, activities, which together form salient impressions. The concept suggests that traits like personality or competence of others can be inferred without interaction and although a single bit of information may not be telling, taken together they can paint a picture of the other person. Through this, individuals may infer traits without (1) having met the other person and (2) without even having communicated with the other person. In this sense, ambient awareness would be present if a person can indicate an impression of others without having actually interacted with them.

As a rather novel concept, research is still limited. So far, ambient awareness has only been investigated in SNS. Pioneering the notion of ambient awareness, Leonardi (2015) first found that simply through being exposed to communication of others in an enterprise social network, employees became aware of crucial metaknowledge (e.g. “who knows what”) and accurately so. Applying this concept to everyday social media use, Levordashka and Utz (2016) found evidence for ambient awareness in Twitter users. Not only was there a general feeling of knowing their Twitter network as a whole but also did they report awareness of specific information in target individuals, for example, their personality, career, and humor. Crucially, this knowledge emerged without direct interaction or communication. It was not predicted by Twitter use, relationship duration, and network size. Subsequently, Krämer et al. (2017) showed that the concept also resonated with Facebook users. They, however, did find a relationship between intensity of Facebook use and self-reported ambient awareness. Based on their data, they go on to suggest that especially for people that are less socially connected, ambient awareness may be a powerful mechanism and contribute to well-being. It is important to note that there are other awareness variables in the literature. For example, social network awareness (Cadima, Ferreira, Monguet, Ojeda, & Fernandez, 2010) and group awareness (Kirschner, Kreijns, Phielix, & Fransen, 2015). These are of a related nature but differ crucially from ambient awareness in that they (1) are not peripheral and indirect (i.e. ambient) and (2) they do not relate to interpersonal impressions of other students.

As of now, ambient awareness has not been investigated in a technology-enhanced learning context. Considering that the online and distance education landscape is still dominated by asynchronous activities in learning management systems (Legon & Garrett, 2018), we suggest that ambient awareness may be key to a better understanding of interpersonal processes and social aspects in these contexts. To the extent that learning management systems and SNS share properties and social mechanisms like message boards, profiles, and updates, we propose that ambient awareness will also emerge in online learning environments implemented through LMS. Moreover, we suggest that this process may be key to understanding how impressions of other salient social actors are formed that then lead to feelings of social presence. As this connection has not been investigated, we attempt to fill this gap in research to better understand how social presence emerges in
online learning environments. Understanding these mechanisms has been shown to be non-trivial in the past (Kreijns et al., 2013; Weidlich & Bastiaens, 2017). Consequently, design recommendations for socio-emotional aspects of online learning are still lacking (Cui, Lockee, & Meng, 2013). Ambient awareness may be a key concept to better understand these complex and nuanced processes.

3. Research questions and general method

RQ1 Do students perceive ambient awareness of others in an online learning environment?
RQ2 Is there a relationship between ambient awareness and activity in the learning environment?
RQ3.1 How many impressions emerge through ambient awareness (versus social interaction)?
RQ3.2 Which types of impressions emerge through ambient awareness (versus social interaction)?
RQ4 Does ambient awareness explain how social presence emerges from a sociable learning environment, i.e. is ambient awareness a mediator controlling for social interaction?

To investigate ambient awareness in online learning environments, in a first sample \(N = 51\), we adopt the paradigm of Levordashka and Utz (2016) to assess if there is a general perception of ambient awareness, as well as specific awareness of certain impressions about target individuals. We go beyond this, by comparing impressions formed through ambient awareness with impressions formed via direct social interaction like communication. Research questions one through three will be answered through this paradigm (see Section 5). In order to embed the concept of ambient awareness in a more general framework of social aspects in online learning (the SIPS model), in a second sample \(N = 169\), we test ambient awareness as mediator between the sociability of the learning environment and social presence (Figure 1). This would then be a second pathway to social presence, one that has not been explicitly considered in social presence research thus far. This will answer our fourth research question (see Section 6).

4. Impressions formed through ambient awareness

4.1. Participants and procedure

Students took part in an optional four-week course on instructional design and the 4C/ID model by Van Merriënboer and Kirschner (2017) in the winter semester of 2017/2018. This course was implemented via the LMS Moodle and featured typical activities like continuous asynchronous message board discussions, regular synchronous chats, individual and collaborative learning tasks. The environment also featured typical properties that are similar to SNS, like profiles with profile pictures, online status, different ways to connect with others and the possibility to browse through the history of message board postings. After concluding the course in week four, students were lead to a survey via a URL in the learning environment. The survey took approximately 15 min to complete and students received no compensation for their participation. The survey was open for duration of one week. Participants were B.A. Educational Science students at the largest distance university in

![Figure 1. Conceptual mediation model (RQ4).](image)
Germany, FernUniversität in Hagen. Sample size is $n = 51$ (41 women) with a mean age of 36.3 years (SD = 11.9).

### 4.2. Measures

Our methods of measuring ambient awareness were inspired by the paradigm of Levordashka and Utz (2016) but adapted in content for the online distance learning context at hand. We first asked participants to indicate their general experience of ambient awareness in the learning environment with a single item, taken from Levordashka and Utz (2016), but adapted for the present context and translated into German:

> It is possible that in some online learning environments, you can form distinct impressions of other students, even without communicating with them. Even with only a few message board postings and some profile information, together they might give you an idea of the person who posts them – what they are like, what they do, etc. Do you experience such general awareness of the people in the learning environment? And to what extent?

Students rated this item on a continuous scale from 1 (not at all) to 5 (to a great extent).

Our second measure sought to identify awareness of individual targets. Participants were presented with a set of five randomly chosen fellow students, one at a time. They were shown name and profile picture of that fellow student and were then asked to indicate if they had engaged in any kind of direct social interaction in the learning environment. After this, they were asked to indicate the impressions they had of the fellow student. This was prompted with the following instruction:

> Even without direct contact, it is possible that you’ve indirectly learned something about that person. Please indicate the category/categories of which you were able to gather an impression. Please listen to your gut feeling and try to answer this instinctively. It’s not important that you’ve gathered deep and accurate impression. Instead it is enough if you feel that you have an inkling, a general idea of that impression category.

If students indicated no social interaction, but still indicated that they had formed impressions of the target, this was counted as an instance of ambient awareness. If students indicated social interaction, the reported impressions were counted as a result of their interaction. Our suggested impressions are such, that they are not directly observable but need to be either inferred through social interaction or attributed from identifying information or behavioral traces (in contrast to Weidlich & Bastiaens, 2017, where impression formation included to an extent directly observable impressions like name, appearance, and age). Through this modification we make sure that these are indeed “processed” and not merely observed characteristics of other individuals. These suggested impressions were: Personality, warmth, competence, learner type, humor, interest in learning subject, motivation for learning, and “other”. Personality and humor was chosen because these are well-documented attribution traits under conditions of spontaneous trait inference (Uleman et al., 2008). Warmth and competence were chose as they are considered the “Big Two” of impression formation (Judd et al., 2005). Additionally, learner type, interest in learning subject, and motivation for learning were chosen as learning-related impressions that were expected to be inferable from behavioral traces in the learning environment. Ambient awareness score was calculated as the sum of reported impressions of an individual toward a given target. As participants could indicate up to eight impressions per person, this resulted in a maximum of forty possible impressions.

We also asked participants to indicate their general degree of activity in the learning environment via the item: “I regularly took part in activities in the learning environment”. Students rated this item on a Likert scale from 1 (strongly disagree) to 5 (strongly agree).

In addition, we calculated an activity score to account for engagement with the activities in the learning environment. This composite score consisted of self-reported (1) participation in chats, (2) activity in chats, (3) activity in message boards, and (4) percentage of postings read in message boards. Sub-scores were added, resulting in maximum of 16 points in activity score.
4.3. Analyses

Our first research question will be answered through a descriptive look at the data. We suggest that evidence for ambient awareness comes from self-reported agreement to the general ambient awareness items and target ambient awareness, the ability to report impression of a given student in the learning environment without having engaged in social interaction this student. Thus, participants indicating that they have formed an impression without interaction were counted as an instance of impression formation. Our second research question will be answered through bivariate correlation between measures of ambient awareness and of activity. In addition, we will conduct linear multiple regression to further investigate the relative predictor influence on ambient awareness. Research question 3.1 will be accounted for by adding the total amount of impressions formed through ambient awareness and social interaction. Research question 3.2 will be answered by looking at the prevalence of different impression types generated through ambient awareness and social interaction. Research question four will be answered in Section 6.

4.4. Results

Regarding the first research question (“Do students perceive ambient awareness of others in an online learning environment?”), we found a mean agreement with the ambient awareness single-item measure of 2.75 (of five, SD = 1.13), indicating that the concept does to a certain degree resonate with students in this sample (Table 1). In addition, students reported on a mean of 1.78 target impressions gathered through ambient awareness, with a minimum of zero and a maximum of five. Taken together, this descriptive data provides evidence for the existence of ambient awareness in this online learning environment.

To answer the second research question (“Is there a relationship between ambient awareness and activity in the learning environment?”), we calculated zero-order correlations through Pearson’s r (Table 2). Results show that, indeed, both general ambient awareness and target ambient awareness correlate highly with general activity and activity score, with overall large effect sizes of $r \sim 0.5$ (Cohen, 1988), $p < .001$. To further investigate these relationships, we conducted two linear multiple regressions, with both general activity and activity score as predictor and general ambient awareness as dependent variable in the first and target ambient awareness as dependent variable in the second. Results indicate that both predictors explained 36.7% of variance of general ambient awareness ($R^2 = .367$, $F (2,45) = 13.02$, $p < .001$). We found that activity score significantly predicted general ambient awareness ($\beta = .50$, $p < .01$), but general activity did not ($\beta = .14$, $p > .05$). Results of our second regression indicate that both predictors explained 31.4% of variance of target ambient awareness ($R^2 = .314$, $F (2,45) = 10.31$, $p < .001$). We found that, again, activity score significantly predicted target ambient awareness ($\beta = .35$, $p < .05$), but self-reported general activity did not ($\beta = .25$, $p > .05$). Thus, our data suggest converging evidence of a relationship between activity in the online learning environment and the emergence of ambient awareness. However, we found that the calculated activity score, albeit also self-reported, performed better as predictor for ambient awareness than the self-reported general activity.

With regards to the validity of the single-item general ambient awareness measure, we found evidence for construct validity. As shown in zero-order correlations, there is a large correlation ($r = .723$) between general ambient awareness and target awareness than between general ambient awareness and activity score.
awareness and general activity as well as activity score ($r = .487–.598$). Moreover, the large correlation between general ambient awareness item and the more specific behavioral ambient awareness score is evidence for convergent validity.

Regarding research question 3.1 (“How many impressions emerge through ambient awareness (versus social interaction)?”), we found that thirty-five students had experienced target ambient awareness and they formed an average of 1.93 impressions of others in the learning environment, with a maximum of five impressions (Table 3). On the other hand, twenty-seven students reported having formed impressions through social interaction with an average of 2.62 impressions, with a maximum of six impressions. This suggests that social interaction is a more effective way to form impression of others, thus a more powerful pathway to knowing fellow students. However, it was also less common as a means to form impressions. In learning environments with low degrees of social interaction, ambient awareness might play an increasingly large role in terms of interpersonal knowledge.

Regarding research question 3.2 (“Which types of impressions emerge through ambient awareness (versus social interaction)?”), we found that certain types of impressions were more likely to be formed through ambient awareness than social interaction and vice versa. For example, 83.3% of students that reported having gathered impressions through social interaction, indicated that they had some impression of the targets personality. This was much less prevalent in ambient awareness impression formation, with only 39.5%. On the other hand, about half of students (50.9%) that had formed impressions through ambient awareness reported having an indication of the targets competence. This was somewhat lower under conditions of social interaction, with 39.8%. Figure 2 shows the prevalence of impression types for both ambient awareness and social interaction (does not add up to 100% because students could gather more than 1 impression per peer). The small percentage of “other” impressions suggests that our suggested impression categories did well in capturing the breadth of impressions.

### 5. Ambient awareness as a pathway to social presence

#### 5.1. Participants and procedure

Participants in this second sample were again B.A. Educational Science students at FernUniversität in Hagen, Germany. Final sample size is $n = 169$ (147 women) with a mean age of 35.5 years (SD = 8.47). Students were recruited during summer semester of 2018 in the regular bachelor’s class instructional design and educational technology as well as the optional four-week course on instructional design, focusing on the 4C/ID model. Toward the end of both classes, students were lead to the survey via a URL in the learning environment. The survey was open for a period of ten days. To account for

### Table 2. Bivariate correlations.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient awareness item (1)</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambient awareness score (2)</td>
<td>.723***</td>
<td>–</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activity item (3)</td>
<td>.487***</td>
<td>.500***</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Activity score (4)</td>
<td>.598***</td>
<td>.530***</td>
<td>.698***</td>
<td>–</td>
</tr>
</tbody>
</table>

*** <.001.

### Table 3. Amount of impressions gathered per type of impression formation.

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>Median</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient Awareness</td>
<td>35</td>
<td>1</td>
<td>5</td>
<td>1.93</td>
<td>2</td>
<td>.90</td>
</tr>
<tr>
<td>Social Interaction</td>
<td>27</td>
<td>1</td>
<td>6</td>
<td>2.62</td>
<td>2.5</td>
<td>1.18</td>
</tr>
</tbody>
</table>

Note: Does not add up to $N = 51$, because a given participants could form impressions through both ambient awareness and social interaction.
potential double participation, students generated an individual code for the survey based on their birthday and mother’s maiden name. Through this, five duplicate entries were deleted from the final dataset, chosen at random.

5.2. Measures

Sociability of the online learning environment was measured with a ten-item measure, validated in Kreijns, Kirschner, Jochems, and Van Buuren (2007), and slightly adapted in wording to be more generally applied to online learning environments that are not necessarily collaborative. Cronbach’s alpha for our sample was .85. Recently developed and improved upon previous measures, we used the ten-item social presence measure (Weidlich et al., 2018; Kreijns, Weidlich, & Rajagopal, 2018). Cronbach’s alpha in the present sample was .91. Social Interaction was measured with a four-item scale that was taken from Wei, Chen, and Kinshuk (2012). In our sample, we found a Cronbach’s alpha of .92. Lastly, we used the general ambient awareness item from Levordashka and Utz (2016), assessed in our first sample (Table 4).

5.3. Analysis

Classical tests of mediation are the Baron and Kenny (1986) procedure and Sobel test (Sobel, 1986). Because these methods have been associated with shortcomings (Hayes & Scharkow, 2013; Shrout & Bolger, 2002), a bias-corrected bootstrapping procedure was used instead. The PROCESS macro for IBM SPSS is a tool for path analysis-based moderation and mediation, as well as conditional process models (e.g. moderated mediation and mediated moderation) (Hayes, 2013). For our

Table 4. Zero-order correlations between SIPS variables in this study and ambient awareness.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sociability (1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social Interaction (2)</td>
<td>.343***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social Presence (3)</td>
<td>.380***</td>
<td>.367***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social Space (4)</td>
<td>.510***</td>
<td>.402***</td>
<td>.451***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambient Awareness (5)</td>
<td>.357***</td>
<td>.236***</td>
<td>.456***</td>
<td>.192*</td>
<td></td>
</tr>
</tbody>
</table>

* <.05, *** <.001.
mediator analysis, the sociability of the learning environment was used as X variable in the mediator model, social presence the Y variable, with ambient awareness being the mediator. We ran the analysis twice, once (1) not controlling for social interaction and again (2) with controlling for social interaction.

### 5.4. Results

Our first model (not controlling for social interaction) explains 26% of variance in social presence, with \( R^2 = .261, F = 29.34, p < .001 \), suggesting partial but substantial mediation of ambient awareness with an indirect effect of .151 [0.061; 0.255]. This suggests that even though ambient awareness explained some of the relationship between the sociability of the learning environment和社会 presence, this mechanism does not account for all of the relationship. According to the SIPS model, some of this relationship should also be explained by social interaction, as a sociable learning environment is conducive to social interaction, which in turn is a driver of impression formation and, thus, social presence (Weidlich & Bastiaens, 2017, p. 2017). Therefore, we tested a second model with the same conceptual relations, but added social interaction as a control variable. Our second model (controlling for social interaction) is slightly better at explaining variance of social presence with 30%, \( R^2 = .306, F = 24.19, p < .001 \). Here, too, we found a partial mediation of ambient awareness with an indirect effect of .122 [0.042; 0.220] (Figure 3).

### 6. Limitations

Our finding is probably not applicable to all online learning settings. It may be important that there are mechanisms in the learning environment that allow for impression formation without social interaction. These mechanisms (or social affordances, see Weidlich & Bastiaens, 2019) can be found in social media and SNS. With regards to the current evidence base, we hypothesize that ambient awareness only arises in environments that are sufficiently similar to these rather sociable environments. Thus, generalizability of our results may be limited to these kinds of learning environments.

Ambient awareness was measured with a single-item for answering our fourth research question. Of course, there are constraints in validity associated with single-item measures and unfortunately reliability could not be estimated in this study. However, there are single-item measures that have been proven to be valid and reliable, job-satisfaction being a prominent case (Wanous, Reichers, & Hudy, 1997). In our case, we present some compelling evidence of convergent validity (i.e. correlation between general ambient awareness and awareness score) as well as construct validity (i.e. ambient awareness mediates between sociability and social presence, as predicted by the SIPS model). This suggests adequate reliability (Drost, 2011).

The design of this study did not allow for assessing impression formation effects of social interaction whilst explicitly excluding ambient awareness effects. Therefore, our comparison of these two impression formation modes may be asymmetrical in that we compare awareness vs. social interaction + ambient awareness. Although a limitation in terms of clean differentiation, this would actually strengthen the evidence for ambient awareness effects in that the share of ambient awareness impressions would be even higher.

---

**Figure 3.** Mediation model results, not controlling for social interaction (left) and with controlling for social interaction (right).
Another limitation is that we had no experimental manipulation in our second sample and therefore our causal assumptions in the mediator model are merely theory-driven but not empirically derived. Therefore, results should be interpreted with caution until our causal assumptions are proven substantiated.

7. Conclusion and discussion

In this study, we found evidence for ambient awareness in online learning environments. Both our general ambient awareness item as well as target ambient awareness suggest that under the conditions of our study, by virtue of being exposed to behaviors of their peers, students formed impressions “on the fly”, possibly without impression formation goals and definitely without direct social interaction. In our first sample of 51 students, 35 participants formed at least one impression through ambient awareness, with most forming two impressions. Our evidence for ambient awareness is in line with work by Levordashka and Utz (2016) and Krämer et al. (2017).

We also found a relationship between measures of activity and ambient awareness. However, there seem to be nuances to this relationship. We found that participant’s general estimation of regularity of activity did not predict ambient awareness. In contrast to this, the activity score, calculated via self-reported engagement with learning activities (e.g. discussions in message boards, synchronous chats), did indeed predict ambient awareness. This aligns with the results of Krämer et al. (2017), who found that intensity of Facebook use (e.g. time spent of Facebook per day, number of Facebook friends, etc.) was associated with ambient awareness. However, our results diverge from Levordashka and Utz’s (2016) findings in that general activity in the learning environment was not a predictor for ambient awareness, but their Twitter use variable was. Here, differences between SNS and online learning environments like LMS may come into play. Where SNS use is mostly synonymous with browsing of feeds and, thus, provides the user with a constant stream of information about others, online learning environments are often different in design. Similarly, social affordances may differ, too (Weidlich & Bastiaens, 2019). Here, students do not have feeds but instead engage with the environment in a more goal-oriented way, for example by looking for relevant information or interacting with peers in learning activities. Therefore, logging in regularly may be a necessary but not sufficient condition for ambient awareness to emerge. Instead, a certain degree of intensity of use and investment into the learning experience may be necessary. Besides activity, a worthy direction of investigation may be how group size (e.g. small classes versus MOOCs) may further moderate the relationships investigated in this study. A first step in understanding social presence with differing groups sizes has been made by Akcaoglu and Lee (2018).

Our results lend support to the notion of ambient awareness in online learning environments, as students were indeed able to form impressions of their fellow students in the learning environment peripherally. This mechanism was comparable to social interaction. Although mean amount of formed impressions was lower than through social interaction, therefore a less powerful pathway to rich interpersonal impression, the higher prevalence of instances of ambient awareness may counteract this to an extent (Metzger, Wilson, & Zhao, 2018).

Interestingly, we found differences in types of impressions that were formed through ambient awareness versus social interaction. Only two types of impressions were more prevalent in ambient awareness, competence and motivation. One interpretation of this may be that impression formation through ambient awareness may transport different kinds of information about others. Here, it seems that the academically related impressions of competence and motivation are more readily transported than more personal impressions like personality and warmth. However, this needs to be investigated in more detail in future studies. Should differential impression formation effects prove to be a reliable phenomenon in online learning environments, design principles specifically accounting for this may be warranted.

Lastly, we were able to show that ambient awareness has explanatory potential in shedding light on the processes that govern the emergence of social presence. More than that, our analysis shows
that ambient awareness explains, to an extent, how sociable learning environments actually lead to a higher degree of social presence. We, thus, propose ambient awareness as a pathway to social presence and worthy of further exploration in the context of socio-emotional aspects of online and distance learning.

Designers of online learning environments that take socio-emotional aspects of online learning into account may want to design for ambient awareness. This may be especially useful in learning contexts that do not necessitate a high degree of social interaction between peers. In sufficiently sociable learning environments, students may be able to form impressions of others and perceive them to be socially present through ambient awareness alone.

Disclosure statement
No potential conflict of interest was reported by the authors.

Notes on contributors
Joshua Weidlich is a PhD student at the Department of Instructional Technology & Media at FernUniversität in Hagen, as well as research faculty at the Department of Technology-Enhanced Learning at University of Education, Heidelberg. His PhD research focuses on investigating how social presence emerges in environments of online distance learning, how it affects learning, and how social presence can be facilitated.

Theo J. Bastiaens is Professor of Educational Technology and Rector Magnificus at Open University in Heerlen, the Netherlands. His research is concerned with distance education, instructional design and innovative learning technology.

ORCID
Joshua Weidlich http://orcid.org/0000-0002-1926-5127

References


