Exploring Co-Presence in Virtual Work: A Literature Review

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Abstract:
In recent decades, virtual work has emerged as a prominent paradigm in the world of employment. Within discussions surrounding virtual work, the concept of co-presence has garnered significant attention. Co-presence facilitates virtual workers to feel integrated into their teams and fosters relationships with colleagues. This research undertakes a comprehensive literature review to delve into the concept of co-presence, its crucial determinants, and the implications it holds. A total of 34 journal articles were scrutinized for inclusion based on their alignment with the research topic. The synthesis of these studies reveals that co-presence plays a pivotal role in supporting virtual work. Furthermore, the alignment of co-presence technology with job characteristics emerges as a critical consideration to ensure technology enhances rather than hinders productivity.

Keywords: Co-Presence; Presence; Virtual Work; Virtual Reality; Computer-Mediated Communications (CMC).


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INTRODUCTION

The virtual work phenomenon has been recognized and used as a new way of working in the last few decades. Some terms related to this phenomenon include remote work (remote working, teleworking, telecommuting), distributed work, flexible work arrangements, and work from home. In general, these terms mean a work arrangement in which workers work from a location separate from the head office or production facility but can communicate with co-workers using technology. Digital, mobile, and social media allow people to be present together virtually in a variety of contexts.

Data shows that before the COVID-19 pandemic, virtual work was not a common practice, but rather a luxury for high-end workers. In the United States, for example, in 2017 virtual work was carried out by only 2.9% of workers, while in Europe, the figure was around 2% in 2015 (Wang et al., 2020). DeSilver (2020) noted that previously these flexible work arrangements were only enjoyed by high-income earners and white-collar workers.

Quoting Eurostat data, Da Silva et al. (2023) noted that before the COVID-19 pandemic, 85% of workers in Europe had never worked from home, while in 2000 the figure was 92%. It can be seen that the increase in these numbers shows a trend that work is done outside the home. Figures in the United States also show a similar trend, that remote working is not a common practice. As a result, when the pandemic struck, most workers and organizations did not have sufficient experience regarding these work arrangements. With conditions requiring work to be done remotely, virtual work has suddenly become the new normal.

A survey by Brynjolfsson et al. (2020) in April and May 2020 showed nearly 50% of workers in the United States were working from home, with 15% already working from home before the pandemic. Over time, many companies are planning a combination of hybrid work arrangements, where some work in the office and others from home. However, remote work arrangements such as those tested at Yahoo! and HP show that the disadvantages of remote work outweigh the positive impacts (Alexander et al., 2020).

As the world moves into a post-pandemic environment, questions about managing work patterns are returning to the fore. Moreover, considering that these changing patterns and preferences of work arrangements also have consequences for economic and social developments, including labor markets and housing choices (da Silva et al., 2023). The discussion about virtual work is filled with pros and cons. On the one hand, virtual work is considered to cut transportation costs, increase time with family, and allow the balance of personal and professional life. Meanwhile, those who oppose highlight the loss of social interaction and togetherness which can have an impact on productivity. Communicating especially with known co-workers has critical implications for organizations trying to use social platforms and other ICT initiatives to increase innovation or interconnectivity within the company (Pettersen, 2016).

One of the concepts that is relevant in discussions about virtual work is co-presence because it has an impact on social interactions between individuals. Co-presence allows virtual workers to feel part of the team and helps them build relationships with their coworkers.

The simultaneous presence of individuals in a shared place or environment is referred to as co-presence. Studies on the topic of co-presence have been conducted in a variety of sectors, including education, migration studies, cyberspace, and intercultural research. Social presence has been identified as an important aspect of fostering a sense of community and engagement in online learning (Gunawardena, 2023). Furthermore, the concept of co-presence has been used to understand the dynamics of various civilizations and the interactions of various social actors where co-presence includes chronological, geographical, sociological, subjective, and material dimensions (Brodowski, et al., 2022). However, it is important to emphasize that co-presence can be fragmented and not always mutually beneficial, requiring careful consideration of power imbalances and varying priorities. (Horn & Casagrande, 2023).

In the context of virtual work, research was conducted by (Raghuram et al., 2019) with a comparative review method of literature. The results of the review found three discussion groups related to virtual work, namely...
telecommuting, virtual teams, and computer-mediated work (CMW). From this research, a lot of important information was found about how best to maximize the potential of the three main research groups as well as several strategies that can be used by organizations to make their work more efficient and productive.

Complementing the research above, this research will present a study of co-presence from a communication perspective, namely computer-mediated communications). In this paper, we will first define related concepts, namely social presence and co-presence. Next, this paper will focus on synthesizing the findings of studies regarding co-presence and virtual work to explore their implications for virtual work. The problem formulation of this research is as follows.

RQ1: What does the conceptual network look like regarding "co-presence" and "virtual work"?
RQ2: What is the distribution of selected articles based on publication time?
RQ3: What is the distribution of selected articles by subject?
RQ4: According to the selected articles, why is co-presence important?
RQ5: According to the selected articles, what factors influence co-presence?
RQ6: What are the implications of the selected articles' findings for virtual work practices?

Social presence theory is one of the most popular constructs used to describe and understand how people interact socially in online environments (Lowenthal, 2010). This theory was first developed by Short et al. (1976) to explain the influence of telecommunications media on communication. Social presence is defined as the degree of prominence between two communicators using communication media. According to them, communication media have different degrees of social presence, and these differences play an important role in how people interact. In other words, social presence complies Short et al. (1976) is the quality of the communication media. Research on CMC (computer-mediated communication) uses this theory to explain that CMC is inherently impersonal due to the lack of nonverbal and relational cues in CMC when compared to face-to-face communication.

This idea was later challenged after several studies on CMC in online learning contexts showed that CMC can support learning which is a social practice. Based on various research, online discussion participants can project their personalities in online discussions and create a social presence using text alone. With this, social presence theory is reconceptualized with a shift in focus from the medium to the user.

Lowenthal (2010) touches on how the development of social presence theory has resulted in the absence of a clear and mutually agreed upon definition of social presence. Moreover, there are several related terms used to describe similar phenomena, such as presence, co-presence, and telepresence.

Several definitions of social presence/presence from experts include non-mediated perceptual illusions (Lombard & Ditton, 1997), the feeling of being with another person (Biocca et al., 2003), the degree to which a person is perceived as a real person in mediated communication (Gunawardena, 1995), the ability of participants in a learning community to project themselves socially and emotionally as real people through communication media (Garrison et al., 1999), the degree to which feelings, perceptions, and reactions are connected with other intellectual entities by CMC through text-based encounters (Chih-Hsiung Tu & Marina McIsaac, 2010) and the student's feeling of being and being part of the class and the ability to interact with other students and the instructor (Picciano, 2002).

The concept of co-presence was first coined by Goffman (1963) to refer to how the physical presence of another person influences an individual's actions. Because this idea was developed before the advent of technology that enabled computer-mediated communication, co-presence was equated with sharing physical space.

However, in its development, experts discovered that physical presence was not a requirement for co-presence, as seen in CMC studies that the dynamics of direct interaction were also found in mediated communication. Schroeder et al. (2001) define co-presence as the subjective sense of being with or co-located with another person in a computer-generated environment. Campos-Castillo & Hitlin (2013) reconceptualize co-presence as the perception of mutual entrainment between actors, where entrainment is the mutual synchronization of
three components, namely attention, emotion, and behavior.

Social integration refers to reciprocity between actors who are present (face to face) in real-time, while system or mechanical integration concerns reciprocity between actors who exist physically removed in space or time. In this latter system, reciprocity must cross space-time (co-presence). Co-presence, according to Giddens (Pettersen, 2016), is an important key to fostering relationships of mutual trust and thus social integration. Therefore, co-presence is essential for getting to know colleagues and learning the implicit rules, norms, and values of social interactions in the workplace, all of which are necessary for completing work tasks. Implicit rules that are essential for meaningful communication are manifested primarily through language and communication and are learned in daily work activities in which employees are socially integrated.

(Pettersen, 2016) found that employees need to build conventional work relationships before they can begin virtual teamwork, explaining that "until someone experiences good drinks and food together and has good social chat, that person will not be on a 'real team' and then be able to use technology to maintain the relationship." Physical meetings are important for building trust and getting to know the other person, elements that virtual outsourcing lacks. Networking and levels of encounter go hand in hand, as do the obligations of co-presence and the physical mobility of academics.

Alterman & Harsch (2017) mention physical co-presence as the basis of the social situation and spatial and temporal proximity as constitutive elements of physical co-presence. Physical co-presence can be established by any of the five sensory modalities of seeing, hearing, smelling, feeling, and feeling to achieve mutual understanding and shared knowledge. Occasional physical proximity is an obligation that accompanies network membership where shared presence makes network members uniquely accessible and respectful of one another, which is essential to commitment. (Higham et al., 2019).

Meanwhile, (LaBrie et al., 2019) define virtual co-presence or the sensation of 'being there' with others in an online space as the feeling evoked by popular social media platforms, smartphone games, and websites through user avatars and profiles.

**RESEARCH METHODS**

This research uses a systematic literature review (SLR) methodology. With this method, the reviewer attempts to gather all known knowledge about the topic area (Irwan, 2023). Part of this goal is to find directions for a specialized field that will thus serve as a basis for future research and theory development. Literature studies will allow the interpretation of existing research from new points of view and combination with previous research (Knopf, 2006).

The object of this research is journal articles taken from search results on the Scopus website (https://www.scopus.com) using the keywords “(co-presence OR co-presence) AND virtual AND work”. From the search results, 118 documents were obtained consisting of 52 conference papers, 50 articles, 6 reviews, 5 book chapters, 2 books, 1 conference review, 1 editorial, and 1 note. Next, 50 articles were manually sorted based on the relevance of the discussion and produced 34 articles which will be reviewed in this paper using the SALSA (Search, Appraisal, Synthesis, and analysis) method (Grant & Booth, 2009).

**RESULTS AND DISCUSSION**

The importance of articles is something that is studied in bibliometrics. The number of citations in an article can be used to estimate its importance. Articles with larger dimensions were referenced more frequently and considered more important, as shown in Figure 1. Next, articles that were more closely related were grouped.
RQ1. Conceptual Networks Related to Co-presence and Virtual Work

Co-occurrence analysis in VOSviewer shows the relationship between five keywords in the article, namely computer-supported cooperation, collaboration, presence, virtual reality, and co-presence.
Q2. Article Distribution by Publication Time

Figure 3. Distribution of the number of documents per year (Source: Scopus.com)

Figure 3 shows an increasing trend in the number of articles using the co-presence concept from year to year, especially in the last five years. This trend shows increasing academic interest in the concept of co-presence. This can also be interpreted as meaning that this concept is increasingly relevant in social life with the development of information and communication technology and also the conditions of the COVID-19 pandemic which limit joint activities.

RQ3. Distribution of Articles by Subject

Figure 4. Distribution of the number of documents by subject (Source: Scopus.com)
Figure 4 shows that the concept of co-presence is discussed in articles from various disciplines, ranging from computer science, social science, engineering, business, and management, to mathematics. From this, it appears that the concept of co-presence has relevance in various fields. This is in line with what is stated by Campos-Castillo & Hitlin (2013) that this concept is firmly positioned in social theory as a medium through which micro-macro influences are achieved. Moreover, as a concept that departs from classical sociology regarding social interaction, co-presence can be applied in the context of direct or mediated communication.

RQ4. Why Co-presence Matters

Of the 34 articles reviewed, there was one article that specifically contained an explanation of the concept of presence (Lee, 2004) by first discussing the previous conceptualization, which includes the subjective or objective social richness of a medium; perceptual or social realism; transportation of self, places, or other people; perceptual or psychological immersion, social interaction with entities in a medium; and social interaction with the medium itself.

From the previous conceptualization, Lee (2004) concluded that presence occurs when the technology user is unaware of the para-authentic nature of the mediated object or the artificiality of the simulated object. With this, virtual experiences can be divided into two groups based on the virtuality of the object, namely para-authentic and artificial. In addition, there are three domains of virtual experience, namely physical (experience of physical objects and environments), social (experience of social actors), and self (experience of self).

He then offers a typology of virtual experiences into six groups, based on the virtual experience domain and virtualization characteristics. From this typology, the concept of co-presence is closest in meaning to social presence, however (2004) assesses that the concept of co-presence places more emphasis on collocation (the feeling of sharing space) between oneself and others, so its application is narrower than social presence which can explain one-way or two-way communication situations.

Lee (2004) states that presence is the core of all mediated experiences, where the human desire to overcome the limitations of human senses through technology is the driving force for the development of media technology and reality simulation. This concept is very relevant to the design and evaluation of various media products and computer interfaces, ranging from television programs, video games, telecommunications, and online learning, to telemedicine.

The importance of co-presence in the context of collaborative virtual environments was discovered in a field study conducted by Gerhard (2003) in a virtual art gallery called CyberAxis. People who are alone in a collaborative virtual environment experience a lack of co-presence and thus experience a significant drop in attendance levels. His research shows that co-presence significantly increases the feeling of presence (Gerhard et al., 2004). Research by Seed et al. (1999) against groups performing tasks collaboratively in virtual spaces shows that people who are immersed in them tend to emerge as leaders in virtual groups, but this advantage is lost in real encounters.

In the context of the COVID-19 pandemic, virtual presence is a solution. (Shelley-Egan, 2020) argued that the pandemic limiting mobility prompted reflection on previous policies that required physical presence. According to him, events held virtually encourage inclusivity in the academic world, because groups who were previously unable to attend physically (for example due to domestic obligations or limited resources) can now get involved. He suggested that good practices related to physical co-presence be adapted and extended to the virtual realm.

The practice of co-presence in the virtual realm is defined as shared mobility (Hughes & Mee, 2021). Sharing mobility experiences with others near and far evokes a feeling of shared presence. This is because the mobility carried out at that time and shared via digital platforms will bring with them the emotions they carry when contemplating mobility in the future.

Research conducted by Cornet et al. (2022) looks at digitalization practices in the workplace environment focusing on the implications of virtual work. Overall, organizational characteristics have real implications for working conditions, worker
vulnerability, and occupational health and safety. The existence of a virtual work platform reconsiders the practice of co-presence between employees in the organization.

**RQ5. Factors Affecting Co-presence**

Study Huang et al. (2018) found that in the context of remote collaboration for tasks involving tangible artifacts, co-presence can improve the quality of user experience as well as performance. For this reason, sharing a two-dimensional visual space is not enough, because it is not enough to provide an understanding of the spatial relationships between objects, so a multimodal three-dimensional visual space is needed.

Subramaniam et al. (2013) conducted research related to the use of the Enterprise System (ES) platform in carrying out collective work where the context of ES use occurs when users (located together or distributed) work to complete tasks at the same time. Research result Subramaniam et al. (2013), the role of ES user interactions in the completion of user-centered collective work has the potential to increase the efficiency of organizational units and the involvement of knowledgeable participants in crossing organizational boundaries in effective and meaningful collective work. The interaction provided by social media provides effective alternative conditions for working in various places and is a solution for managers and team members to continue working together even though they are geographically dispersed.

Yu et al. (2021) highlight the use of avatars for remote consultations. Although the customization feature was able to increase body ownership and perceived personal co-presence, it was found that point cloud reconstruction-based avatars were better than virtual characters in terms of perceived co-presence, social presence, behavioral impression, and humanity.

In the context of creative collaboration, co-presence is also important. The study (Schiemer et al., 2022) focuses on how co-presence can be organized as a basis for creative collaboration in songwriting. By conducting ethnography on collaborative songwriting activities online and offline, it was found that co-presence in online and offline environments can be regulated to optimize productivity. Regulation is carried out by increasing/decreasing nimbus (individual visibility) and focus (object of individual attention).

The literature on Self-Disclosure suggests that co-presence mediates the effects of visual and behavioral realism on self-disclosure. A meta-analysis of studies on Self-Disclosure between face-to-face interviews compared with computer-administered interviews found that self-disclosure was higher with computer-mediated interviews than interviews with face-to-face interaction (Vacherand-Revel, 2017). This shows that some are less embarrassed to open themselves virtually. They are considered more comfortable because they are not face-to-face.

In addition, digital technology makes distant places feel imaginatively available, thereby instilling a strong sense of co-presence of being in two places at once (Moran, 2022). This explains the research conducted by Iglésias et al. (2008) regarding the use of a peer-to-peer collaborative haptic assembly simulator that allows two users to simultaneously perform an assembly task using a haptic device. The simulator can provide adequate haptic interaction when both users perform remote assembly (assembly of one user's object with an object held by another user). The haptic feedback obtained during remote assembly can further enhance the sense of co-presence among users that is associated only with visual feedback.

The level of presence can be influenced by various factors (Nam et al., 2008a). A user's perception of presence depends on the extent to which spatial, auditory, and haptic object transformations in a virtual environment mimic the same types of real-world object transformations. Witmer and Singer(Nam et al., 2008a)have proposed four intermediate factors that can inhibit or facilitate presence: control (degree of control, immediacy of control, anticipation of control, mode of control, and physical control of the environment), sensory (sensory modality, richness of the environment, sensory multimodality, consistency of multimodal information, degree of movement perception, and active search), distraction (isolation, selective attention, and interface awareness), and realism (graphical realism, consistency of information with the objective world, meaningfulness of experience, and separation anxiety/disorientation).
Attendance levels may also be influenced by the nature of the task itself as well as differences in individual preferences for information presented in various modalities.

Even though it occurs in cyberspace, virtual co-presence cannot be separated from the material world, as shown by Schwarz et al. (2022). Virtual work cannot be done from locations with an unstable internet connection or without electricity. Bailenson et al. (2006) explained the obstacles of co-presence namely (1) most problems with visually mediated communication systems result from bandwidth delays in video conferencing or the conspicuous conditions offered by other virtual solutions and (2) in mediated communication the addition of visual features is not always beneficial and sometimes it can be counterproductive. Specifically, Bailenson’s findings suggest that showing another person’s face during an interaction tends to be more effective when the purpose of the interaction is social than when it is purely task-oriented. Instability in internet network performance can also be triggered by computing overload due to other applications running or intense activity in holo-meeting scenarios, with varying network conditions (Lang a et al., 2022).

Apart from that, the shortcomings felt in co-presence are mainly the emotional side that is obtained when compared to face-to-face interaction. Nam et al. (2008) found that ICT does not provide the emotional satisfaction needed to build trusting working relationships among virtual team members; even geographical and social proximity is important for the problem-solving process in the scope of work. Thus, studies of online communication and virtual work environments need to include employees’ social relationships and work practices. Relationships formed from informal ties in the workplace are not only a source of career advancement but can also increase job satisfaction, feelings of belonging, trust, and well-being at work (Ryan & Mulholland, 2014).

Clayton et al. (2018) assess that technology still has limitations in replicating real/physical co-presence. Although digital interactions can bring individuals to connect with others, mediated experiences are not completely the same as face-to-face experiences. Even very rich and immersive 3D interfaces lack the resolution and fidelity of real-world Face-to-face interactions (Taylor et al., 2013).

One of the things that cannot be felt about co-presence is the absence of physical touch when interacting. Due to the importance of touch in physical interactions, many efforts have been — and continue to be made — to introduce interpersonal touch via haptic devices in virtual environments et al. (2018). Many reviews identify haptic feedback as one of the most frequently studied immersive qualities that influence social presence, apart from visual representation and interactivity. According to Kim et al. (2004), the addition of haptic communication between human users in a Social Virtual Environment (SVE) contributes to the shared user experience.

The use of technology in critical work characteristics suggests that the high levels of electronic dependence and lack of presence that often accompany virtual work can negatively influence critical psychological states of experienced meaningfulness, experienced responsibility, and knowledge of outcomes. However, these adverse effects can be reduced through the development of intimacy and identification, as well as by increasing task significance, autonomy, and feedback (Gibson et al., 2011).

In an educational context, Primdahl et al., (2021) in his research show how the ‘move’ from physical learning to distance learning affects teachers’ job satisfaction. Distance learning is based on the assumption that all students have well-functioning access to digital devices, communication platforms, as well as WiFi. For different reasons, this is not the case for everyone, especially for all the new arrivals of children and adolescents with migrant and refugee backgrounds who are the focus of her research. Teachers need greater effort because it is difficult to reach their students during the implementation of the COVID-19 pandemic lockdown. Physical co-presence cannot be replaced by virtual co-presence in this context.

RQ6. Implications of Co-presence Study
Findings for Virtual Work Practices

From the findings described, it can be concluded that co-presence supports virtual work. Typology of presence (2004) helps to identify the type of presence that needs to be prioritized according to the characteristics of virtual work. Matching the facilitation of co-
presence technology with job characteristics is very important, so that the technology does not hinder/disrupt work, for example, visual features that are not useful (Bailenson et al., 2006). Subramaniam et al. (2013) also emphasized the importance of designing user-centered virtual work platforms.

For remote work that requires physical collaboration, physical co-presence needs to be built to as closely as possible simulate the real situation, as with transformations of spatial, auditory, and tactile objects (Nam et al., 2008b), multimodal 3D visual space sharing (Huang et al., 2018), an avatar display that as closely as possible reconstructs the user's appearance (Yu et al., 2021), haptic feedback (Iglesias et al., 2008b; Kim et al., 2004).

For creative collaboration, workers must be given balanced opportunities between working together and working alone. Collaboration and discussion allow creative ideas to emerge while working alone allows workers to develop existing ideas in a more focused manner. Therefore, to optimize productivity, managers need to regulate co-presence (Schiemer et al., 2022).

Managers also need to pay attention to aspects of emotional satisfaction, job satisfaction, and feelings of belonging to workers (Nam et al., 2008b; Ryan & Muholland, 2014), by increasing task significance, autonomy, and feedback (Gibson, 2011). Resource support also needs to be considered to support co-presence (Primdahl et al., 2021; Schwarz et al., 2022).

CONCLUSION

The COVID-19 pandemic has made every individual do everything they can to connect with their surroundings, including their work environment, for the sake of collective survival. Technological developments make co-presence easier to do and have even become a daily part of human life.

However, humans are social creatures who rely on body language and other nonverbal cues to communicate. Human perceptual systems have been adapted through evolutionary processes for the perception of real-world environments. Virtual communities will not replace organic communities, which are characterized by close relationships in traditional societies; rather, they will be additions to them, building on them and perhaps strengthening them.

Communication environments that offer fewer verbal and/or nonverbal cues (in virtual meetings) can produce a level of intimacy equivalent to face-to-face communication, although it may take longer. Although virtual world designs have been adapted over the years to facilitate co-presence needs. New technology in virtual meetings can increase or decrease the maximum achievable sense of presence, but it is up to humans to follow through.

New work arrangements certainly bring new opportunities and challenges for organizations and individuals. The issues outlined in this article demonstrate the need for discretion and caution in approaching, designing, and implementing remote work programs. The role of managers is equally important to provide support for virtual work initiatives and to address risks related to employee well-being.

Academic literature also needs to keep up with the rapid development of virtual work practices, so that it can provide a reference for organizations so they can implement virtual work optimally. In addition, the development of virtual work practices needs to receive attention from policymakers to ensure these practices do not hurt worker comfort, health, and safety, as well as to provide incentives for companies that implement good virtual work practices.

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