

Teenagers and Videoconference Fatigue: A Preliminary Analysis from an Affordance-based Approach

Lee, Chei Sian

Nanyang Technological University, Singapore | leecs@ntu.edu.sg

Li, Benjamin Junting

Nanyang Technological University, Singapore | benjyli@ntu.edu.sg

Wu, Qian

Nanyang Technological University, Singapore | qian003@e.ntu.edu.sg

ABSTRACT

The Covid-19 pandemic has led to the widespread use of videoconference (VC) technologies, particularly in education and this trend is projected to continue. Prolonged VC usage can lead to “videoconference fatigue” (VCF). While research on factors contributing to VCF has been conducted among university students, there is limited research on younger students (especially teenagers). To fill this gap, this study adopts an affordance-based approach to identify VC affordances (resources and constraints) contributing to VCF in teenagers. Specifically, the objectives are to examine if (a) VC affordances (visibility, information, and availability), and (b) demographic profiles (age and gender) have effects on VCF among teenagers. A large-scale survey was conducted and responses from 491 teenagers were analyzed using Hierarchical Regression Analysis. Results indicate that the three identified VC affordances contribute to VCF in teenagers. In addition, teenage girls and older teenagers are more prone to VCF.

KEYWORDS

Videoconference, Videoconference Fatigue, Teenagers, Affordance, Online Learning

INTRODUCTION

The Covid-19 pandemic has led to the widespread adoption of videoconference (VC) technologies (Beauford, 2023). According to Fortune Business Insights (2021), the global videoconferencing market was valued at approximately USD 6.28 billion in 2021. It is projected to reach 14.58 billion by 2029, underscoring the prevalence of its role in work and school. Specifically, VC has become an integral part of mainstream education due to the rise of hybrid and online learning, with teachers and students embracing this technology (Kharbach, 2022). Additionally, this trend has been aided by the availability of many VC platforms such as Zoom, Skype, Microsoft Teams, and Google Meet. While VC software has its benefits, it has its challenges which include the absence of non-verbal cues (AI-Samarraie, 2019; Lawson et al., 2010) and prolonged VC usage can lead to fatigue, exhaustion and burnout (Doty et al., 2022; Riedl, 2022). Some termed this as “Zoom fatigue” (Bailenson, 2021; Massner, 2021), while others used a more general term known as “videoconference fatigue” (VCF) (B. J. Li & Yee, 2022). Following Li & Yee (2022), we use the term VCF, defined as non-pathological tiredness arising from videoconferencing which manifests in physical, cognitive, emotional and social ways suggesting the multifaceted nature of the problem. Notably, while VC platforms facilitate remote education, communication and collaboration, we need to be mindful of the resources afforded by VC software that can impose constraints and potentially lead to VCF.

VCF emerged due to the COVID-19 pandemic because of the sudden shift to online learning and increased reliance on VC technologies to facilitate online classes (Bailenson, 2021). While schools may have resumed in-person classes, VC continues to be a common mode of communication for students (Cray, 2021). It is essential to continue to address VCF and improve remote communication effectiveness while minimising the negative impacts of VC. Specifically, studies highlighted that VCF affects students’ well-being (Okabe-Miyamoto et al., 2022; Petchamé et al., 2022). Notably, these studies focused mainly on university students (de Oliveira Kubrusly Sobral et al., 2022; Massner, 2021; Moralista et al., 2022), and research on younger students (especially teenagers) is urgently needed.

Despite the widespread usage of VC in schools, we are still unclear about the affordances of VC and their effects on VCF among teenagers. It is vital to study VCF among them because VC has become integral to their educational systems and social lives. In addition, familiarity with VC technologies can give teenagers an advantage in the job market as the technology is used for virtual job interviews, networking events and other professional interaction and development opportunities (Julsrud et al., 2014; Sears et al., 2013). Hence, understanding how VC affordances lead to VCF can help to mitigate VCF and contribute to future academic and career success in teenagers.

In terms of affordance-based research, Sundar et al. (2015) suggested that affordances manifest in the form of distinctive technological attributes that shape the nature of communication. Hence, we focus on the features of VC technology that are critical for online learning and interaction among teenagers. Specifically, VC technologies support knowledge delivery and in-class communication by providing visual, audio, and other interactive affordances (Wu et al., 2022). We identify three types of affordances of VC technologies embedded in the common features found in most VC technologies. They are *visibility-related affordances* (enable users to see and be seen by

others) during VC, *information-related affordances* (help with information processing and understanding), and *availability-related affordances* (provide user's availability and contact information). It is also important to note that VCF can impact individuals of all ages and genders, and the extent of the impact may vary based on individual circumstances and other factors. Regarding *gender*, workplace research has shown that female workers tend to experience more emotional exhaustion and stress related to VC use than males, which could potentially contribute to VCF (B. J. Li et al., 2022). *Age* is also another factor. In particular, younger users (e.g. teenagers) may find it more challenging to communicate effectively through VC, leading to additional cognitive and emotional load (Yan et al., 2021). These factors can potentially contribute to VCF.

The objectives of the present paper are hence two-fold. The first objective is to investigate VC affordances by focusing on visibility, information and availability-related affordances and their effects on VCF among teenagers. The secondary objective is to examine if teenagers' demographic profiles (e.g. age and gender) also affect VCF. An affordance-based approach is pertinent to this inquiry as it can shed light on the resources critical for teenagers to achieve their learning and communicating goals while being mindful of constraints that may contribute to VCF. Hence, this study attempts to answer the following research questions: *What VC affordances contribute to VCF in teenagers? Do demographic factors have effects on VCF among teenagers?*

RELATED WORK

An affordance-based approach

The term "affordances" was defined by Gibson (1986) in ecological psychology as action possibilities in relation to the properties of a given environment. Subsequently, Norman (1988) emphasized that affordances should be perceivable in the context of product design. In terms of communication, Sundar et al. (2015) suggested that affordances are technological attributes that manifest particular features to shape the nature of communication (Sundar et al., 2015). Taken together, the affordances of VC can be perceivable and they provide resources to enhance communicators' competence and ability and enable effective and successful communication (Lee et al., 2014). However, they may also impose constraints and affect communication outcomes negatively (Clark & Brennan, 1991; Lee et al., 2007) and here we focus on VCF.

This study focuses on three types of affordances. The camera function on VC facilitates *visibility-related* affordances, which enable a user to see self and other users' behaviors (Treem & Leonardi, 2013). *Information-related* affordances enable users to organize, control, process and manage information (Väljataga et al., 2010; Zhou et al., 2018) and audio, video, and chat features of VC technologies facilitate this. *Availability-related* affordances enable users to get immediate responses or updates from other users (Gibbs et al., 2013; Lee, 2010) due to the users' status availability and contact information shown on the platform. While these affordances provide critical resources, they may also impose constraints on the users during a VC session. For instance, visibility-related requires visual attention which can be demanding especially for long VC sessions (Li et al., 2022). Information-related affordances introduce additional cognitive load and users may feel stress to internalize the different types of information exchanged during the VC session (e.g., audio, video, chat, hyperlinks, presentation slides). The availability-related affordances may introduce undue pressure to be present and engaged during a VC session.

Videoconference fatigue

As schools shut down worldwide due to the pandemic, lessons moved online with the use of VC platforms as a primary mode of communication to facilitate classes (C. Li & Lalani, 2020). Along with this increased adoption, many reports of VCF soon began to surface as usage of the technology peaked. Correspondingly, researchers have developed the Zoom Exhaustion & Fatigue (ZEF) scale to measure VCF (Fauville et al., 2021). The instrument comprises 15 items spanning five dimensions of fatigue, namely general, social, emotional, visual and motivational fatigue. Studies utilizing the ZEF scale have found moderate to high levels of VCF among students, which suggests that it is a prevalent issue in educational settings (e.g., Montag et al., 2022).

Researchers and educators have expressed concerns towards VCF among students especially teenagers and have sought to explore the underlying factors and consequences. Pingkiany et al. (2021) suggested that the intense duration and frequency of VC are potential causes of VCF among students, especially since the technology is used every day in their virtual classes, instructor consultations and group discussions. Others found that students who used videoconferencing for educational purposes experienced difficulty in learning and reported greater emotional, cognitive and/or physical problems compared to face-to-face classes (Massner, 2021).

METHOD

Data collection

A survey was conducted between July and October 2022 with 626 teenagers from four secondary schools in Singapore. Administrators from the schools facilitated the data collection. Participation from the teenagers was voluntary and no monetary compensation was provided. As the teenagers were below 21 years of age, consent was

provided by their parents before participation. The racial distribution of the sample mirrored the multi-racial demographic of the Singapore population. The study was approved by the authors' Institutional Review Board.

The survey comprised of scales measuring VCF, VC affordances, and demographic characteristics. First, VC affordances were measured as follows: (1) 3 items for visibility-related affordance, (2) 3 items for information-related affordance (3) 3 items for availability-related affordance. The three constructs were respectively measured by five-point Likert scales and the means (M) and standard deviations (SD) were shown in Table 1. To examine the validity, the confirmation factor analysis (CFA) was conducted and the average variance extracted (AVE) values ranged from .53 to .70, reaching the recommended value (i.e., .50) for acceptable convergent validity. Further, the correlations among the three constructs were smaller than the square root of the AVE on the diagonal, suggesting that the discriminant validity was acceptable. The construct reliability of the three constructs was acceptable with values ranging from .77 to .88. Second, the measure for VCF was adapted from Fauville et al. (2021). Due to time constraints set by the school which resulted in a shorter survey length, we used an abridged version of the original scale by using three items measured on a five-point Likert scale (i.e., "How tired/ exhausted/ mentally drained do you feel after videoconferencing?"). The construct reliability was .92. Finally, the gender and age of participants were collected. In particular, the participants' gender was measured by a multiple-choice question with three choices—female, male, and others. Participants were further asked to indicate the length of a typical VC session they attended by answering a multiple-choice question.

Data analyses

To investigate the effects of VC affordances on VCF, a hierarchical linear regression was conducted. The first block focused on demographic factors (i.e., gender and age). Here, gender was computed into a dummy variable with 1 = female and 0 = others. Next, the second block was VC affordances (i.e., V-Affordance, I-Affordance and A-Affordance). To ensure the absence of multicollinearity among all independent variables, this research further examined the variance inflation factor (VIF) of the variables. The VIF values were all smaller than 10 (i.e., ranging from 1.01 to 1.29), indicating the absence of multicollinearity (Pituch & Stevens, 2016).

Construct & Items	Standardized Loadings	M	SD
Visibility-related affordances (V-Affordances)		3.00	1.07
Whenever I have my camera on, I am anxious knowing that others are watching me	0.78		
Whenever I have my camera on, I feel constrained when I see myself on the screen	0.76		
Whenever I have my camera on, I feel anxious when I see myself on the screen	0.92		
Information-related affordances (I-Affordances)		2.93	0.93
I am often distracted by the excessive amount of information in videoconferencing.	0.80		
I find that I am overwhelmed by the amount of information that I process from videoconferencing.	0.93		
I find it difficult to process all the information during videoconferencing.	0.78		
Availability-related affordances (A-Affordances)		3.30	0.87
Sometimes I don't want to be contacted through videoconferencing	0.58		
I feel pressured that I have to be available on videoconferencing	0.85		
I am pressured to respond to videoconferencing requests	0.73		

Table 1. VC Affordances Constructs Measurements (N = 626)

RESULTS

Profiles of participants

After omitting participants with missing ages and gender, we had 491 participants and 61.5% were females. The age range of the participants was 14 years to 20 years old as adults in Singapore are 21 years old and above. The average age of participants was 16.7 years old (SD = 1.19). Around 63.5% of participants indicated that a typical VC session was more than one hour while 26.3% reported that the length was between 45 minutes to one hour (see Figure 1).

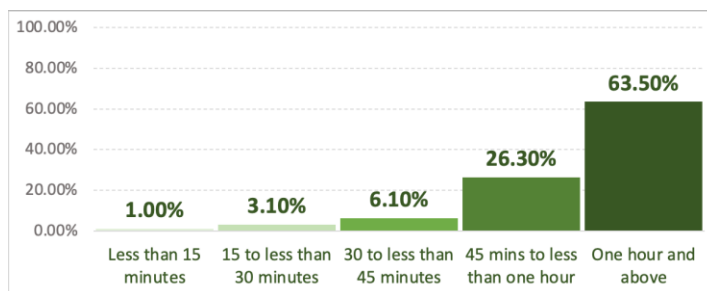


Figure 1. The Length of a typical Videoconference session (N = 491)

Hierarchical linear regression results

The results (see table 2) indicate that the VC affordances were all significant in predicting teenagers' VCF ($p < .001$). A-Affordances were the most significant in increasing teenagers' VCF followed by I-Affordances and V-Affordances. Both gender ($p < .05$) and age ($p < .05$) significantly predicted VCF. The results suggested that teenage girls and older teenagers experienced higher VCF. Our model accounted for 34% variances.

Independent variables	Dependent variables = videoconference fatigue (VCF)		
	Beta	Standardized beta	T-values
First block: Demographic factors			
Gender (Female = 1, Others = 0)	0.18	0.093	2.47*
Age	0.066	0.080	2.14*
Adjust R ²		0.051***	
R		0.23	
Second block: Videoconferencing Affordances			
V-Affordance	0.13	0.15	3.81***
I-Affordance	0.27	0.26	6.34***
A-Affordance	0.33	0.30	7.31***
Change in Adjust R ²		0.29***	
Final Adjust R ²		0.34	
R ²		0.34	
R		0.59	

*** $p < .001$, * $p < .05$.

Table 2. Hierarchical Linear Regression Results (N = 491)

DISCUSSION, IMPLICATION AND CONCLUSION

This preliminary exploratory study has identified three types of VC affordances (visibility, information and availability) that contribute to VCF in teenagers. Recognizing and addressing these issues help teenagers feel more comfortable and confident using VC. First, to our knowledge, this is the first study that draws on an affordance perspective to investigate VCF among teenagers. Specifically, an affordance view on VC provides a theoretical foundation to understand the resources and constraints of VC. The availability and visibility-related affordances expect users to respond in real-time in VC can be stressful for teenagers, if they are not accustomed to speaking or being seen on camera especially in a class setting. Additionally, VC presents challenges for information processing due to the limitations of the VC technology (e.g. time lag) and the potential distractions that can arise in the VC information environment (B. J. Li & Yee, 2022). Instructors must be aware of these challenges and avoid cognitively demanding VC class activities. We also found that teenage girls are more prone to VCF. A plausible explanation is that females generally feel more pressure to perform and participate during VC sessions, leading to stress and fatigue (Fauville et al., 2021).

There are practical implications. For educators and policymakers, this study can help them understand the resources and constraints of VC from the perspective of VCF in teenagers and tailor class VC activities for their students based on our findings. The affordances identified in this study can provide guidance to raise awareness of how VC can be used to reduce VCF. In terms of research implication, this study has taken an important first step to expand our knowledge on VCF in teenagers using an affordance-based approach. Specifically, instead of focusing on any particular feature or technology, an affordance view on VC use provides a theoretical foundation to understand teenagers' perceived resources that VC can offer. This helps to provide a more holistic view of the technology and a context for future VC research. There are some limitations in the present study that warrants future research. First, the participants were based in Singapore, and teenagers in other countries may have different VC exposure and as such may perceive VC affordances differently. Future studies should address the generalizability of this study to other areas and cultural groups. Given the multifaceted nature of VCF, a survey may be limited in its ability to capture the full complexity of VCF. While this study serves as a good starting point to understand VCF among teenagers, controlled experiments may need to be conducted to assess the contributing factors of VCF more accurately.

ACKNOWLEDGMENTS

This work was supported by the Tier 1 Grant from Ministry of Education Singapore (Grant Number: RG34/21).

REFERENCES

- Al-Samarraie, H. (2019). A scoping review of videoconferencing systems in higher education: Learning paradigms, opportunities, and challenges. *International Review of Research in Open and Distributed Learning*, 20(3). <https://doi.org/10.19173/irrodl.v20i4.4037>
- Bailenson, J. N. (2021). Nonverbal overload: A theoretical argument for the causes of zoom fatigue. *Technology, Mind, and Behavior*, 2(1). <https://doi.org/10.1037/tmb0000030>
- Beauford, M. (2023, January 30). *The state of video conferencing in 2023*. GetVoIP. <https://getvoip.com/blog/state-of-conferencing/>
- Clark, H. H., & Brennan, S. (1991). Grounding in communication. In L. Resnick, L. B. M. John, S. Teasley, & D. (Eds.), *Perspectives on Socially Shared Cognition* (pp. 127–149). American Psychological Association.
- Cray, M. (2021, September 30). *Is video conferencing still important in education, post-COVID?* Applied Global Technologies. <https://www.appliedglobal.com/video-conferencing-in-education-post-covid/>
- de Oliveira Kubrusly Sobral, J. B., Lima, D. L. F., Lima Rocha, H. A., de Brito, E. S., Duarte, L. H. G., Bento, L. B. B., & Kubrusly, M. (2022). Active methodologies association with online learning fatigue among medical students. *BMC Medical Education*, 22(1), 74. <https://doi.org/10.1186/s12909-022-03143-x>
- Doty, T. A., Knox, L. E., Krause, A. X., Berzenski, S. R., Hinkel-Lipsker, J. W., & Drew, S. A. (2022). Keep it brief: Videoconferencing frequency and duration as predictors of visual and body discomfort. *International Journal of Human-Computer Interaction*, 0(0), 1–12. <https://doi.org/10.1080/10447318.2022.2132358>
- Fauville, G., Luo, M., Queiroz, A. C. M., Bailenson, J. N., & Hancock, J. (2021). Zoom exhaustion & fatigue scale. *Computers in Human Behavior Reports*, 4, 100119. <https://doi.org/10.1016/j.chbr.2021.100119>
- Fauville1, G., Luo, M., Queiroz, A. C. M., Bailenson, J. N., & Hancock, J. (2021). *Nonverbal mechanisms predict Zoom fatigue and explain why women experience higher levels than men*. Lemann Center. <https://lemanncenter.stanford.edu/paper/nonverbal-mechanisms-predict-zoom-fatigue-and-explain-why-women-experience-higher-levels-men>
- Fortune Business Insights. (2021). *Video conferencing market size, share, trends & growth [2029]*. Fortune Business Insights. <https://www.fortunebusinessinsights.com/industry-reports/video-conferencing-market-100293>
- Gibbs, J. L., Rozaidi, N. A., & Eisenberg, J. (2013). Overcoming the “ideology of openness”: Probing the affordances of social media for organizational knowledge sharing. *Journal of Computer-Mediated Communication*, 19(1), 102–120. <https://doi.org/10.1111/jcc4.12034>
- Gibson, J. J. (1986). *The Ecological Approach To Visual Perception* (New edition). Psychology Press.
- Julstrup, T. E., Denstadli, J. M., & Hjorthol, R. J. (2014). Business networking, travel tiredness, and the emergent use of video conferences. *International Journal of Sustainable Transportation*, 8(4), 262–280. <https://doi.org/10.1080/15568318.2012.662580>
- Kharbach, M. (2022, November 9). *7 of the best web conferencing tools for teachers*. Educational Technology and Mobile Learning. <https://www.educatorstechnology.com/2012/07/great-7-web-conferencing-tools-for.html>
- Lawson, T., Comber, C., Gage, J., & Cullum-Hanshaw, A. (2010). Images of the future for education? Videoconferencing: a literature review. *Technology, Pedagogy and Education*, 19(3), 295–314. <https://doi.org/10.1080/1475939X.2010.513761>
- Lee, C. S. (2010). Managing perceived communication failures with affordances of ICTs. *Computers in Human Behavior*, 26(4), 572–580. <https://doi.org/10.1016/j.chb.2009.12.009>
- Lee, C. S., Watson-Manheim, M. B., & Chudoba, K. M. (2014). Investigating the relationship between perceived risks in communication and ICT-enabled communicative behaviors. *Information & Management*, 51(6), 688–699. <https://doi.org/10.1016/j.im.2014.05.008>
- Lee, C. S., Watson-Manheim, M. B., & Ramaprasad, A. (2007). Exploring the relationship between communication risk perception and communication portfolio. *IEEE Transactions on Professional Communication*, 50(2), 130–146. <https://doi.org/10.1109/TPC.2007.897608>
- Li, B. J., Lee, E. W. J., Goh, Z. H., & Tandoc, E. (2022). From frequency to fatigue: Exploring the influence of videoconference use on videoconference fatigue in Singapore. *Computers in Human Behavior Reports*, 7, 100214. <https://doi.org/10.1016/j.chbr.2022.100214>
- Li, B. J., & Yee, A. Z. H. (2022). Understanding videoconference fatigue: A systematic review of dimensions, antecedents and theories. *Internet Research, ahead-of-print*(ahead-of-print). <https://doi.org/10.1108/INTR-07-2021-0499>
- Li, C., & Lalani, F. (2020, April 29). The COVID-19 pandemic has changed education forever. This is how. *World Economic Forum*. <https://www.weforum.org/agenda/2020/04/coronavirus-education-global-covid19-online-digital-learning/>
- Massner, C. K. (2021). *Zooming in on zoom Fatigue: A case study of videoconferencing and Zoom fatigue in higher education* [PhD dissertation]. <https://www.proquest.com/docview/2555927490/abstract/E8936C5A44134330PQ/1>
- Montag, C., Rozgonjuk, D., Riedl, R., & Sindermann, C. (2022). On the associations between videoconference fatigue, burnout and depression including personality associations. *Journal of Affective Disorders Reports*, 10, 100409. <https://doi.org/10.1016/j.jadr.2022.100409>
- Moralista, R., Oducado, R. M., Robles, B. R., & Rosano, D. (2022). *Determinants of Zoom fatigue among graduate students of teacher education program* (SSRN Scholarly Paper No. 4161936). <https://papers.ssrn.com/abstract=4161936>

- Norman, D. (1988). *The design of everyday things*. Basic Books.
- Okabe-Miyamoto, K., Durnell, E., Howell, R. T., & Zizi, M. (2022). Video conferencing during emergency distance learning impacted student emotions during COVID-19. *Computers in Human Behavior Reports*, 7, 100199. <https://doi.org/10.1016/j.chbr.2022.100199>
- Petchamé, J., Iriondo, I., & Azanza, G. (2022). “Seeing and being seen” or just “seeing” in a smart classroom context when videoconferencing: A user experience-based qualitative research on the use of cameras. *International Journal of Environmental Research and Public Health*, 19(15), Article 15. <https://doi.org/10.3390/ijerph19159615>
- Pingkiany, A. J., Wong, V., & Valentina, A. (2021). *A Creative Communication of Overcoming Zoom Fatigue*. 148–152. <https://doi.org/10.2991/assehr.k.210805.024>
- Pituch, K. A., & Stevens, J. P. (2016). *Applied multivariate statistics for the social sciences: Analyses with SAS and IBM's SPSS*. Routledge.
- Riedl, R. (2022). On the stress potential of videoconferencing: Definition and root causes of Zoom fatigue. *Electronic Markets*, 32(1), 153–177. <https://doi.org/10.1007/s12525-021-00501-3>
- Sears, G. J., Zhang, H., H. Wiesner, W., D. Hackett, R., & Yuan, Y. (2013). A comparative assessment of videoconference and face-to-face employment interviews. *Management Decision*, 51(8), 1733–1752. <https://doi.org/10.1108/MD-09-2012-0642>
- Sundar, S. S., Jia, H., Waddell, T. F., & Huang, Y. (2015). Toward a theory of interactive media effects (TIME). In *The Handbook of the Psychology of Communication Technology* (pp. 47–86). John Wiley & Sons, Ltd. <https://doi.org/10.1002/9781118426456.ch3>
- Treem, J. W., & Leonardi, P. M. (2013). Social media use in organizations: Exploring the affordances of visibility, editability, persistence, and association. *Annals of the International Communication Association*, 36(1), 143–189. <https://doi.org/10.1080/23808985.2013.11679130>
- Väljataga, T., Pata, K., & Tammets, K. (2010). Considering students’ perspectives on personal and distributed learning environments in course design. *Web 2.0-Based E-Learning: Applying Social Informatics for Tertiary Teaching*, 85–107. <https://doi.org/10.4018/978-1-60566-294-7.ch005>
- Wu, Y., Sun, Y., & Sundar, S. S. (2022). What do you get from turning on your video? Effects of videoconferencing affordances on remote class experience during COVID-19. *Proceedings of the ACM on Human-Computer Interaction*, 6(CSCW2), 353:1-353:21. <https://doi.org/10.1145/3555773>
- Yan, L., Whitelock-Wainwright, A., Guan, Q., Wen, G., Gašević, D., & Chen, G. (2021). Students’ experience of online learning during the COVID-19 pandemic: A province-wide survey study. *British Journal of Educational Technology*, 52(5), 2038–2057. <https://doi.org/10.1111/bjet.13102>
- Zhou, Q., Lee, C. S., & Sin, S.-C. J. (2018). Beyond mandatory use: Probing the affordances of social media for formal learning in the voluntary context. *Proceedings of the Association for Information Science and Technology*, 55(1), 608–617. <https://doi.org/10.1002/pra2.2018.14505501066>