What do Users Actually Look at During Videoconference Calls? Exploratory Research on Attention, Distraction Effects, and Gender

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Abstract

During the pandemic, mandatory shutdowns of schools and businesses forced people to communicate almost exclusively through computer-based video communications tools. The transition brought challenges, as users adjusted to the new environment, wading through various distractions, all the while learning the technology on the go. The existing research into Zoom meetings says little about what users actually observe during these meetings. This discovery-based study explores what users attend to in remote meetings by employing eye tracking technology. Study participants joined an interactive meeting and then watched a recorded Zoom video. We found that participants do pay attention to others in the meetings, and their gaze patterns differ between small and large groups. For small groups, they look away from the screen about one-third of the time. They look at their own video, but women look at themselves more than men. Participants notice distractions but spend little time looking at them.

1. Introduction

The COVID-19 pandemic started in late 2019, and the spread of the virus increased dramatically around the world in early 2020. As the pandemic progressed in 2020, millions of people found themselves working from home. Meetings migrated from offices and conference rooms to computer screens. The most common remote meeting system that people turned to was Zoom, but there were also competitors, such as Cisco's Webex and Microsoft's Teams. Use of all such systems grew dramatically during the pandemic. Statistics from Zoom illustrate this rapid growth. When Zoom was created in 2013, it had 400,000 initial users who generated 200 million meeting minutes in the first year of use [1]. By April 2020, Zoom had 300 million daily meeting participants, and in March 2021, the software supported over 3.3 trillion annual meeting minutes [1].

Adjusting to remote meetings was difficult for many workers, as they also adjusted to having children at home, being cut off from their friends and family, and dealing with the multiple issues that came with the pandemic. Moreover, the sudden and mandatory switch to videoconference meetings resulted in technological dilemmas (e.g., security, software operation, bandwidth, etc.), as well as dilemmas stemming from the lack of personal interactions. The most publicized manifestation of the shift has been referred to as "Zoom fatigue," whereby people who take part in multiple remote meetings find themselves exhausted by the end of the day [2]. While "Zoom fatigue" and other videoconferencing-related problems may lessen as the economy opens up and workers start to return to the office, some workers, such as those who work for Twitter, may never work in an office again [3]. As work from home will continue in the near future, there is still much to be learned about remote meeting software systems.

One area of research that has not yet been thoroughly investigated is what meeting participants are actually observing and doing when they are attending remote meetings. While it may be difficult for others to determine what is going on when users turn off their video and mute their microphones, through eye tracking, we can determine what people are looking at when they are in a remote meeting. For example, how much attention do they pay to others in the meeting? How are they affected by the inevitable on-screen distractions, such as people eating, or pets entering a participant's frame? To what extent are people looking at themselves during the meeting? Are there differences across

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gender? And do observation patterns differ between small meetings (five participants) and large meetings (25+)? Questions such as these are important for meeting participants, who may not realize what they pay attention to during meetings. But they are also important to meeting organizers, so they can plan effective meetings, and to system designers, who can gain insights into the user experience.

To help answer these questions, we designed and implemented a purely exploratory study on what meeting participants observed during a remote meeting. We used eye tracking to follow the gaze of participants in a genuine small meeting, organized just for this purpose. We also had them observe a recording of a larger meeting with more than 25 participants, while having their gaze tracked and recorded. We used Webex rather than Zoom, but our findings should generalize to Zoom and Teams and other similar platforms, given the study was not designed to capitalize on features unique to Zoom. We found that participants do pay attention to others in the meeting, but they also spend a surprising amount of time looking at things that are not on the computer screen. They look at themselves during the meeting, but not as much as might be expected. Women look at themselves more than men do. Participants notice distractions but spend less time looking at them than we expected. Finally, gaze patterns differ between small and large meetings.

In the next section of the paper, we review the limited literature to date on videoconference meetings during the pandemic. We then explain our research design and data collection in more detail. Next, we present our findings, followed by a discussion of the meaning and implications of our results.

2. Literature Review

In the social sciences, research can be categorized, by its purpose, into three groups: exploratory, descriptive, and explanatory [4, 5, 6]. The purpose of exploratory research is to examine issues or phenomenon that is little understood and whose subject is relatively new and has been lightly investigated if at all [7]. As a first stage of scientific inquiry, exploratory research is intended to build a necessary understanding to enable the design and execution of a more systematic and extensive study (Figure 1). Induction describes the process whereby the observations of behavior gained in an exploratory study lead to empirical generalizations about that behavior. These generalizations become the basis for theory. Deduction describes the process by which specific hypotheses are derived from theory.

These hypotheses are then tested by the collection of relevant data. The data are themselves new observations, which may lead to modified empirical generalizations, and so on [4]. The work described here is inductive, as we start with observations of behavior, from which we tentatively move to empirical generalizations.

As the pandemic is still with us (as of this writing), and as people have been transitioning to extensive remote meeting participation only over the last 18 months, relevant research is relatively new and sparse. Most of the research that has been reported to date has focused on "Zoom fatigue," which has included consideration of differences between men and women in their experiences in remote meetings. This research on fatigue is only relevant here as it provides a stepping off point for consideration of other behavior users engage in during videoconferencing. There has been little research so far on other behaviors, such as the effects of on-screen distractions and on the number of meetings attendees.
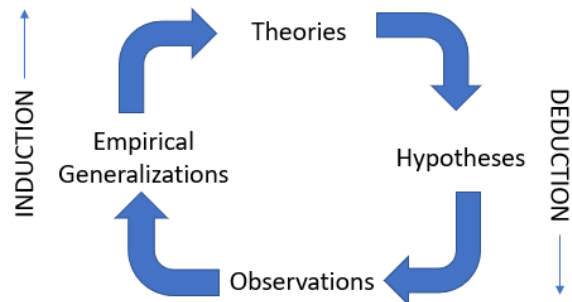

Figure 1. "Wheel of Science," adapted from Babbie, 2012, Figure 1-3

One of the advantages of using video conference platforms is that they allow people to participate in meetings from their homes. They can dress more comfortably, sit in a favorite chair, and have easy access to snacks and drinks. This same advantage can turn into a disadvantage, as the home setting introduces environmental elements that distract from the meeting, e.g. children, pets, and doorbells. We could not find any systemic study of the effects of these distractions on attention or effectiveness, although some studies acknowledge the existence of such distractions [8, 9]. A survey by Zippia.com [10] of 2000 Americans working from home listed checking emails, texting, multitasking, eating, and social media as the top five behaviors people were engaging in during a remote meeting. However, while these environmental elements may distract the participant who is working from home, they also distract the other meeting participants, who might fixate on a

person who is eating, or on a person petting a cat on the desk, or on another person who jumps up to retrieve an Amazon delivery when the doorbell rings, taking their attention away from the meeting and its contents.

The focus of most related research to date, "Zoom fatigue," was first identified in 2020 [2]. The research investigates the elements of videoconferencing that cause people to turn inward, to focus on themselves. Bailenson [11] hypothesized about four possible causes of Zoom fatigue: excessive amounts of close up eye gaze (also known as "hyper gaze"), increased cognitive load, increased self-evaluation from staring at oneself during a meeting (referred to as "mirror anxiety"), and constraints on physical mobility. Fauville and colleagues [12] created a scale for measuring Zoom fatigue, and they used it to investigate Bailenson's hypotheses in a convenience sample of 10,591 participants [13]. They found that feelings of being physically trapped, mirror anxiety, and hyper gaze were all associated with higher levels of fatigue.

Other recent research has investigated videoconferencing through the lens of gender. Fauville and colleagues [13] also found that women were more fatigued than men, and women reported higher levels of mirror anxiety, feelings of being physically trapped, and of hyper gaze than did men. According to Hancock, "women have a greater propensity to self-focus than men when they are in the presence of a mirror. That prolonged self-focus can produce negative emotions [14]." In a related study, Pfund and colleagues [15] investigated the relationships between remote meeting participation and self-image satisfaction. With a survey sample of 438 women, they found that respondents who engaged in more meeting participation reported lower levels of face and body satisfaction. "Furthermore, video chatting appearance comparison was associated with more frequent usage of certain Zoom features, such as the 'touch up my appearance' feature, and more time spent looking at oneself on video calls" [15, p. 2038].

Finally, there have been limited observations of the effects of meeting context on videoconferencing. As for the number of participants in a meeting, most research to date appears to be descriptive. For example, Espin and Rojas [16] found that the average number of participants increased by 15% in the companies they surveyed, compared to before the pandemic, due to the capabilities offered by remote meeting software. Interestingly, large meetings are associated with more multitasking by participants [9], as are long meetings, morning meetings, and regularly recurring meetings.

3. Research Design

Participants were recruited through an email announcement at a large midwestern university. Ten graduate students, five females and five males, ranging in age from 25 to 35, participated in the study. Participants represented several different national origins and ethnicities. Three were from China, one from South America, one from Europe, one from the Middle East, and four were North Americans, including one African-American. Each experimental session had two parts: participating in a live, interactive Webex meeting, and watching a recorded video of a publicly distributed Zoom meeting. The interactive Webex meeting lasted about 15 minutes, and watching the video took 10 minutes. Upon arrival, each participant was seated in front of a 22" monitor with an eye-tracking system mounted underneath the monitor. Prior to starting the study, each participant's gaze was calibrated and then validated. We employed the SensoMotoric Instruments (SMI) RED 250 eye tracking system, which records gaze movements every four milliseconds. This equipment allows a remote and unobtrusive recording of gaze behavior of participants, including those wearing eyeglasses or contact lenses.

For the interactive Webex meeting, we fixed the position of the on-screen meeting participants, so that the same people always appeared in the same frames for each separate meeting. Four people participated in these meetings: the participant, the meeting moderator (one of the researchers), a researcher, and a confederate. All of the meeting participants were male, except for the female confederate, and the participant (who could be either male or female). We also included a user given the androgynous name of "Pat Martinez," whose frame was blank (the video and audio were turned off), resulting in five meeting windows or frames on the screen. Because all experimental participants were graduate students, the topic for the meeting discussion was the factors participants thought would be important for choosing a university at which to work. All participants were familiar with the moderator, but they had no prior knowledge of the other researcher or the confederate. Each meeting started with the moderator introducing each person and explaining the purpose of the meeting. It was followed by a question about the career preferences of the participants. Everybody was involved in the discussion, with study participants speaking most of the time.

We introduced two distractions into these meetings. About 5 minutes into each meeting, the researcher started to eat some snacks and to drink from a colored (as opposed to clear) bottle, and later, about 10 minutes

into the meeting, the confederate stood up and started moving her laptop to a different location in her room. Both distractions were introduced at approximately the same points in each meeting. Neither the researcher nor the confederate talked during their distractions. After the meeting ended, each participant was given a short break and proceeded to the second part of the study.

The second part involved watching the first 10 minutes of a recorded and publicly distributed Zoom video from a New Zealand city council meeting. The video started with a 5x5 matrix window, with each frame occupied by a meeting participant. Because the meeting had more than 25 participants, the locations of participants occasionally shifted, as one participant or another began to talk. After watching the video, each subject was compensated $25 for her/his participation and released.

4. Measures

Data on gaze movements can be analyzed based on specific focused areas of research interest, generally referred to as areas of interest (AOIs). AOIs allow the quantitative comparison of gaze metrics that fall within the identified regions and the drawing of inferences as to which area drew more attention at any point of time [17, 18]. For the interactive Webex meeting, we constructed six AOIs. Five of those AOIs were equal size rectangle shapes of the meeting windows. The sixth AOI covered the meeting's controls (e.g., microphone mute button, video stop button, chat, etc.) at the bottom of the screen. All six AOIs were available for the entire duration of the meeting.

We also created two AOIs for the two distractions. Unlike the first six AOIs, these AOIs were designed to activate at certain times and to close once the distractions ended. For the recorded Zoom meeting video, we created 25 AOIs, one each for the 25 windows of Zoom meeting participants. Gaze behavior of participants in this study was measured in terms of fixation duration and fixation frequency on the AOIs. Additionally, we used the software's built-in "gridded AOI" feature, which created 10x10 grids for the Webex meeting and 8x8 grids for the recorded Zoom video (see Figure 4 for how this looks). We focused on the total gaze dwell time and the number of revisits into these gridded areas. (A visit is measured as the gaze of a participant entering an AOI, so a revisit is measured as a return of the gaze to that AOI.) These measures on a specific target area are regularly used as a metric for eye behavior and cognitive processing [19-22].

5. Findings

We present our findings in three categories: attention, distractions, and gender.

5.1. Attention

On average, for the small Webex meeting, participants devoted most of their gaze on meeting participants to the moderator, followed by the other researcher, the confederate, themselves and the blank frame (Figure 2). However, they spent almost one-third (32%) of their time looking at something other than the meeting.
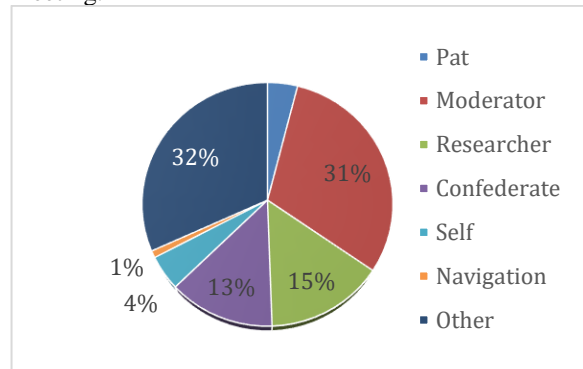
Figure 2. Proportion of Gaze Time During the Interactive Webex Meeting.

There was some variance on where, in the meeting space, participants gazed the most (Figure 3). While six participants looked most often at the moderator in the lower left frame, one looked primarily at themselves (top left frame), two looked mostly at the other researcher (top center), and one looked at the confederate (top right).
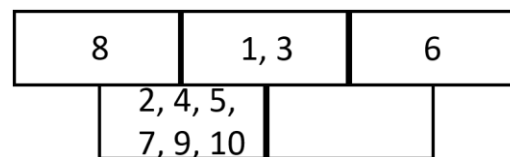
Figure 3. Layout of the Webex Meeting Space.
Note: Each number represents a participant in the frame of their majority gaze.

For the recorded video, where the study participant was an observer and not a meeting participant, the average gaze time centered on the location of the speaker (Figures 4 & 5), which garnered about 25% of the total gaze time. Interestingly, with more visual stimulation on-screen, compared to the meeting with

only five people, participants looked off-screen less often (11% compared to 32%).

3.8	1.84	1.06	1.29	1.31
2.82	2.27	4.28	1.18	1.09
1.2	3.12	4.28	1.64	1.13
1.61	6.56	25.28	3.31	1.59
6.25	7.11	3.13	1.34	0.83
			> 10%	
			> 6 & < 10	
			> 3 & < 6	

Figure 4. Average Gaze Percentages per Frame for the Recorded Zoom Meeting.

Figure 5. Heat Map Indicating Relative Gaze Times per Frame for the Recorded Zoom Meeting.

5.2. Distractions

All of the participants noticed the two distractions in the Webex meeting, however briefly. For the eating and drinking distraction, they spent 3 seconds on average looking at it (range: 1.1. to 7.5 seconds). For the changing background distraction, they looked at it for 5 seconds on average (range: 0.4 to 21.9 seconds).

5.3. Gender

As expected, based on the studies reviewed previously that dealt with "mirror anxiety" and gender differences, there were differences in the time women spent looking at themselves, compared to men. On average, women spent 7.7% of their gaze dwell-time looking at themselves, compared to 1.3% for men. The difference was statistically significant (one tailed test, t = 1.98, df = 8, p = .041). One woman spent 20% of her gaze time looking at herself, which skewed the data distribution. Replacing her value with the average for the group (4.8%), the difference between women and men was more distinct (one tailed test, t = 2.65, df = 8, p = .015). Another way to measure the difference is the number of gaze visits each person made to the frame that contained the video of themselves: women averaged 133 visits, while men averaged 17.

6. Discussion

The results of this study, while heavily exploratory, provide some insights that should be useful for everyone who plans to participate in or lead video-streamed meetings in the future. Likewise, our findings should be of interest to researchers actively looking at interpersonal communication between online group members. In order to begin addressing the general research questions presented earlier in the paper, we measured participant attention in both a synchronous meeting in which they actively participated, and in an asynchronous meeting that had been previously recorded.

Returning to one of our initial research questions, disparate attention patterns were observed between the differently-sized groups. The results showed that the size of the group may have discouraged the study participants from straying from the discussion, even when the meeting was recorded. This interpretation of the results is based on the plurality of the gaze time being focused on the primary speaker of the recorded video, which featured a larger number of group members than the interactive meeting in which the plurality of participant gaze was offscreen. Why might participants in remote meetings be less distracted by larger groups, even when they are not actively participating? One possible explanation is that online meetings are often plagued with temporal problems (e.g., "No, you go first") that face-to-face groups are less likely to experience due to differences in social presence [23]. One can imagine that the larger the group, the more likely group members are to accidentally interrupt each other. This could mean they feel added trepidation to instinctively speak without being invited first, so they are more attentive for cues for their turn. Of course, the experimental setting may have also discouraged the tendency for members of large groups to multi-task as they might otherwise be tempted to do [9], and study participants were located in a neutral workspace without windows, artwork, or other distractions [24]. Participants were aware that they were being monitored and understood the eye-tracking technology, so the Hawthorne effect may have been at least partially present.

Regarding the issue of on-screen distractions and the lack of attention being paid to speaking group members, we found that all ten study participants briefly noticed our planned distractions at a minimum, but on average, the duration of their divided attention was not as lengthy as expected. Both of the distractions lasted seconds longer than even the maximum duration of gaze diversion we measured, so it appeared that the distracting behavior was briefly acknowledged by each participant, who then quickly returned their attention to the discussion. One mitigating influence in the meetings with these distractions was the interactivity of the discussion. Participants were actively engaged because they were expected to be involved in the discussion, so distractions may have been quickly judged as unimportant and disregarded in order to maintain focus. By comparison, some similar distractions were found in the recorded meeting, but once they were judged as irrelevant to the discussion, study participants did not appear to return focus as quickly, often becoming distracted by group members in other frames or by something off-screen. Additionally, in the interactive meeting, we found that only 4 percent of participant gaze was devoted to their own image, which was also a smaller percentage than expected. Again, this may be a similar case of feeling obligated to pay attention in order to contribute to the discussion.

Finally, self-monitoring was also found to be a distraction to meeting participants, but it was not as much of an issue as we expected, and it disproportionately affects women. While the statistically significant result for percentage of "self-gazing" may have been unduly swayed by one outlier participant, the raw counts for the number of times each participant returned to his or her own frame provide additional evidence for the gender difference.

6.1. Contribution to Research

Because of sparse previous research on the distracting behavior of online group members and how it affects the attention of others, we hope that this study will provide a launchpad for other research in this area. The primary contribution of this exploratory study is to identify videoconferencing behavior that may be of interest in future research and may provide insights for future theory development. Our physiological measurement using eye-tracking technology provides a glimpse of what videoconferencing looks like objectively, from the perspective of the participant who is sitting at home.

The findings for distractions also add insight to limited previous research comparing participant attention and behaviors during variably-sized online group meetings. Because of the inductive nature of this initial study, future research efforts can build on these empirical results and re-examine theory based on earlier generations of distributed group communication. One example is Attention Restoration Theory, a theory that has been used to describe the temptation for online communicators to transfer their attention to distracting behavior because it requires less sustained effort than staying on task [23]. Recent work has reappraised this theory under the increased frequency of videoconferencing during the pandemic and found that remote workers faced with back-to-back meetings tend to fatigue faster than in pre-pandemic conditions due to the effortful attention that is expected [24].

That line of research suggests that distracting behavior can be avoided by generous use of the mute audio/video options to reduce the time spent worrying about one's own distracting behavior, a concern that was not as prominent when meeting via chat or telephone conferencing was popular – the time when Attention Restoration Theory was developed. Our results add further insight to those new suggestions by quantifiably measuring self-gaze while in the presence of others' distracting behavior. While one of our study participants spent an inordinate amount of time self-gazing, that appeared to be an outlier and, instead, the behavior of others served as the opportunity for effortless attention for the other participants. That result suggests that it would be more worthwhile for videoconference attendees to resist the need to look at others during meetings, but that would be impractical. Subsequent studies that observe videoconferencing participants during multiple consecutive meetings may find even more effortless attention being exhibited and how sources of distraction might change over time.

6.2. Contribution to Practice

We designed the experimental setting to resemble typical online meeting spaces that were commonly used during the COVID-19 pandemic and appear destined to remain common in the future. Because the prevalence of these online meetings has drastically increased over the past two years, and in many cases, the migration to online meetings was sudden, little consideration has been given to what appropriate behavior in these settings should be. Since our study incorporated some of the common distractions reported by others [10], we wonder if the attention and gaze exhibited by study participants reflects that of group members in business organizations, and whether group members eventually become desensitized to distracting behaviors.

We found that study participants behaved like "model group members" when they were actively engaged in the discussion. Our findings support recommendations that, in the interest of keeping group members engaged, online groups should be absolutely clear about the hoped-for goals for each meeting, and that moderators are sure to include all group members at any time during the discussion [25].

Our findings could also be useful to designers of remote meeting systems. The extent to which the behaviors we have identified would be considered problematic would present opportunities for new features designed to deal with them. For example, participants in meetings of small groups look away from the screen one-third of the time – if this is seen as a problem, what features might be designed to keep them more focused on the meeting? Similarly, our participants noticed the eating and moving distractions we created but spent very little time looking at them. What if the distraction was of longer duration, such as a cat that stayed on the desk of a participant and was (almost) always visible on screen? The cat would probably garner more attention, and more sustained attention, than our designed distractions. One simple solution would be to include a "dump the cat" emoji that participants could enable, from the same point where they can now enable emojis for clapping and performing a 'thumbs up' gesture.

6.3. Limitations and Future Research

This study focused on one communication medium, so its findings should not be extrapolated for other modalities. With organizations looking into the idea of maintaining the remote working environments created by the pandemic, online meetings will be one of the prime means for communication. It will benefit organizations to have a better understanding of what contributes to online communication effectiveness in the context of video conferencing.

Future research should consider the strength of pre-existing interpersonal ties between the participants in the online meeting. Haythornthwaite [27] examined the interpersonal ties among communicators and the use of technological media to continue or enhance the communication channel and found that the stronger the interpersonal tie, the more likely communicators will rely on socially-constructed norms to guide acceptable behavior. Comparatively, group meetings among members sharing weaker ties are more likely to require interventions in order to re-establish behavioral norms. Communication researchers believe that, given time, online groups will adopt behavioral norms similar to

those seen in face-to-face groups, but doing so takes longer [28]. One-time groups like those in our study, and in a significant number of organizational settings, likely never reach that point in a single meeting.

For that matter, group dynamics also likely plays an important role when discussing implications with online meetings and the effectiveness of the communication within that meeting [29], but that was not the focus of the current study. This study consisted of group meetings among participants that were meeting for the first time. Groups with no history may focus attention differently than groups with history in the context of online meetings. During the course of an online meeting, established groups with strong cohesion might perceive communication constraints such as distracting behaviors and nonverbal cues differently than would less cohesive group or even zero-history groups.

Future research should also investigate the extent of video conference users' focus on other people vis-à-vis the background of those people. The nature of online meetings with fewer people tends to not only emphasize close up eye gaze (hyper gaze) [11], but also bring the background environment of the people into closer focus. How do the elements of the speaker's background affect other users? Fixation duration on faces and the background could be compared in studies employing eye tracking technology. Furthermore, future research may investigate the link between communication volume (words produced in interactive meetings) and gender. Results from empirical research suggest that a communication medium plays a role in how much information is conveyed [30]. Does gender affect how much is communicated and how does volume, subsequently, affect the visual attention of users?

Finally, because of logistical reasons, we were unable to alter the order in which study participants engaged with the group meetings. All participants took part in the interactive Webex meeting first, followed by the recorded Zoom meeting video. Whether some of the results obtained are due to an ordering effect cannot be ruled out, but we stress this was an exploratory study. Future research involving similar methods should try avoiding this by planning a random order of the meetings to which participants are exposed.

7. Conclusion

Whether the meeting software is named Webex, Zoom, Skype, Teams, or another product from a myriad list of videoconferencing applications, every indication is that organizations will be using software of this kind for the foreseeable future. In order to effectively meet

and complete tasks over videoconferencing, group leaders need to understand the behavioral pitfalls that can potentially derail meetings, including onscreen distractions. The findings of this study suggest that, if group members are not distracted by others for a prolonged amount of time, they are still likely to find something to become preoccupied with, such as their own image. The empirical observations we report here provide a starting point for both theory development and for the next steps in development for both meeting managers and user experience designers.

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