Critical Review of Leilani Battle, Danyel Fisher, Robert DeLine, Mike Barnett, Badrish Chandramouli, and Jonathan Goldstein. 2016. Making Sense of Temporal Queries with Interactive Visualization. In Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems (CHI '16). ACM, New York, NY, USA, 5433-5443.

The article, “Making Sense of Temporal Queries with Interactive Visualization” by Battle and colleagues (2016) was published through the CHI conference in 2016. The article was contributed by Microsoft’s research team that studied the use of a visualization tool called StreamTrace in temporal queries. The tool was aimed for users of data stream management systems to improve writing and interpreting their queries.

In this journal review, concepts surrounding the paper and critiques about the article will be discussed. The review will also suggest additional aspects in which further research can be done in the field of information visualization in human-computer interaction with respect to the issues raised.

Article Summary

StreamTrace is a visualization tool built on top of a web analytical tool known as Tempe (Fisher et al., 2014) that uses Trill language. In StreamTrace, there are four different components including a workflow diagram, timeline view, linked highlighting, and tooltips. In the workflow diagram, a series of query operations are linked to show “joining” of streams. The timeline view features bars to represent time in linear which is one of the central part of the tool as interactions would take place in this visualisation. The timeline view also acts as a monitor for users to track time events which is often handwritten. For the linked highlighting and tooltips, these two features are in conjunction with the timeline. The linked highlighting provides users a mental representation of the duration and when a single event would occur while the tooltip provides the details and associated contents of an event. Although the tool did not shorten the time of users to complete the tasks, users found it useful in verifying different types of queries and helped them shape a detailed mental model of the queries.

Field Contribution

There are three main contributions addressed in the article based on the visualization tool developed. The first contribution is it provides deeper understanding of the complex concept of temporal queries used in data stream management systems (DSMS). Following Microsoft’s development of Tempe (Fisher et al., 2014) for collaborative analysis development, the paper extends the work to assist data analysts using the system due to its complexity of online and offline temporal data. Using the programming language for temporal queries in large datasets known as Trill, the developers were able to structure and debug their query with the visualization tool. With a visualization tool in place, it was argued to assist data analysts and other parties who wish to learn about the system to understand how temporal data work and be able to debug them.

Another contribution is the presentation of a solution for visualizing temporal queries in DSMS. Battle and colleagues (2016) has found difficulties of users to write accurate query statements despite having a correct description of the behaviour they wanted to produce. This kind of visualization is novel yet provides convenience to users to quickly identify where the error is. Furthermore, the research extends on past literature on interaction (Card and Mackinlay, 1997; Dix and Ellis, 1998) to propose a new type of chart containing two dimensions of text and time with an element of highlighting to link the two dimensions. With a visualization tool in place on Tempe, users were able to identify the effects and interactions of query operators throughout several data streams at the same time.

In addition, the article was able to present a mental model for their users to understand and produce queries with the visualization. Battle and colleagues (2016) pointed out that the users lacked ability to track the temporal aspects when having to validate what the output of DSMS queries would be unless they wrote out the timelines by hand. With the visualization of a timeline on screen, users do not need to draw it by hand and helped them in terms of verification and confirmation of a working query by having the events line up temporally and having linked highlights to show the history of each data stream event. Moreover, the tooltips in StreamTrace also provided content description for users to identify specific details to assist them with the debugging process. Thus, it provides a novel debugging system that is based on both visual and textual elements to reduce complexity.

Critical Reflections

From the results of the studies, they have demonstrated that their visualization tool was useful in constructing different type of queries. However, they have furthered observe that certain queries were not helpful to the user especially those not related to temporal tasks. This was because they have chosen specific set of tasks and operators to test new users' learnability of the tool. The selection was also limited in which only four tasks each involving a different Trill operator was used in the lab study. As such, it can be argued that the usability of the tool cannot be fully explored or evaluated as they neither use all possible operators of Trill nor did they carry out tasks with overlapping operators to investigate the factors affecting the usage of the visualization tool. In fact, the authors have also explained that there was a large variability in the user performance which could be the cause of the complexity of temporal queries (Battle et al., 2016). If that is the case, whether the tool did help simplify temporal queries for the user is questionable.

Besides that, the study (Battle et al., 2016) concluded that StreamTrace was able to help users debug their queries by locating the erroneous code and identify the cause of the error. However, they found that users did not improve efficiency in completing the task given to them. This leads to a question of whether the tool was practically useful. Despite the users finding it useful in terms of guiding a mental model of how the queries work, they did not construct a query with a shorter duration with the tool. It is unknown whether the tool is not practical for use or that the discounted time used by users was spent on interpreting the visualization instead.

Apart from that, in the methods section of the study, the researchers (Battle et al., 2016) have explained the use of Tempe as an environment for live coding that helps users to complete code by having a user type part of a command having semi-autonomous completion to focus on semantics of query construction. In contradiction, the study found that users still faced syntax errors when they were performing the tasks which resulted in compilation errors that even the visualization tool could not take effect. Hence, the researchers could have reconsidered building onto Tempe while having these difficulties or allow time for amateur users to go through a learning activity before starting on the tasks. An alternative was to allow users to use a heuristic approach and speak aloud their thought process to get better evaluations on how they are using the tool.

Future Work

The current state of art has proposed live programming as an important aspect of tools in terms of real-time feedback (Kubelka, Robbes & Bergel, 2018). Tempe was mentioned as one of the debuggers for data analysis that allows live programming between programmers (Kubelka, Robbes & Bergel, 2018). Future research can incorporate instant transformation of values on the timeline visualization to enhance it into an immediate signal processing view. This will allow multiple programmers to collaborate and save time on compiling the code as well as avoiding syntax errors.

In contrast, future work can build on cross-referencing between visualizations such as having the part of code highlighted when the user hovers over the timeline bars to identify the erroneous code more efficiently. Besides that, suggestions or tips can be added to the visualization that advices on the most common errors based on the operators used in the code. That way, users can correct their query before having a syntax error and as a way of learning how to use the debugger tool.

Conclusion

In conclusion, the article has contributed to the information visualization field in various aspects of temporal queries which can be useful in data analysis. Although there can be some improvements to the tool it relies on, the authors have designed it based on user needs and requirements from experts and thus, may need new users to learn about constructing queries more deeply before being able to naturally grasp the use of the visualization tool. Future work can build on real-time visualizations and promote cross-referencing to enhance the tool for more effective interactions and use.

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Critical Review of Gloria Mark, Yiran Wang, Melissa Niiya, and Stephanie Reich. 2016. Sleep Debt in Student Life: Online Attention Focus, Facebook, and Mood. In Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems (CHI '16). ACM, New York, NY, USA, 5517-5528.

Gloria Mark, Yiran Wang, Melissa Niiya, and Stephanie Reich were the authors of the article published in the CHI conference in 2016. They came from two different departments, the School of Education and Department of Informatics. While the context is centred around technology, it was interesting that authors from the education field were involved in the study probably due to the target population of college students or the impact on students' health and academic performance the study may imply.

In this review, concepts surrounding the paper and critiques about the article will be discussed. The review will also suggest additional aspects in which further research can be done to understand the behaviour of multitasking in the human-computer interaction aspect with respect to the issues raised.

Article Summary

While the usual discussion is based on sleep being affected by technological use, the authors have suggested to research on the opposite which was how sleep might affect technological use, particularly how often college students would switch their focus, known as multitasking. They have documented that despite students getting shorter amounts of sleep, there was an association with higher self-reported productivity and higher occurrence of multitasking on the computer the following day. This multitasking was measured by the switching of attention between devices as well as switching between tasks on the same device. The study also reported that college students who lacked more sleep tend to spend time more on Facebook that represented a leisure activity the following day and the lack of sleep may result in negative emotions.

Field Contribution

Previous research (Mark et al., 2014) have found that college students spent more time on technology use when they were more stressed. However, the current paper has extended it by turning technology use to be the independent variable and used the lack of sleep as a measure of the frequency of multitasking in college students. This suggests that the lack of sleep of users should be considered before technology use rather than being an effect of technology use. Thus, instead of designers having to improve sleep habits caused by technology use as previous work has implied, the focus will divert towards designing technology use to accommodate the performance of sleep-deprived users. This is an important finding as this changes the rationale behind designs to support low cognitive load as the user performance baseline may be lower than expected if they are already sleep-deprived. It further suggests interfaces to be customized for individuals affected by their sleep patterns.

Besides that, Jin and Dabbish (2009) outlined seven types of self-interruption in users including adjustment, break, inquiry, recollection, routine, trigger and wait. Among this categorization, focus should be put on "break" because they speculated different reasons for behaviour of multitasking as the task being boring or frustrating, or even people being mentally or physically tired. The current paper then contributes to this aspect by giving evidence that people may be distracted from being mentally tired caused by sleep deprivation. By highlighting higher frequency of switching between tasks and a lower focus duration being observed in sleep-deprived college students, the two studies (Jin & Dabbish, 2009; Mark et al., 2014) support lack of sleep being a motivation drive of multitasking, resulting in performing a simpler task which was the use of Facebook over their initial

task. This offers an alternative factor in explaining the mechanism of online multitasking so that this type of behaviour can be applied in other context of designs.

Furthermore, despite the view of social media being the cause of sleep deficiencies in previous studies (O'Keeffe and Clarke-Pearson, 2011), the current paper suggested that social media was also considered a leisure activity for college students to socialize, escape from reality, as well as a distraction from their current task. This puts social media in a positive light and as the college students have self-reported higher productivity in their work despite their higher use of social media. However, a recent study by Lau (2017) following the publication of the current paper have suggested that social media as a multitasking tool showed lower academic performance in students. Thus, it can be presumed that college students have a lower productivity compared to what they have self-perceived. This illustrates multitasking towards a position that can be detrimental to a user's performance and as such, designers should take note of the trade-off between multitasking and user's performance.

Basically, the paper has contributed to the field of multitasking by supporting a bi-directional relationship between sleep patterns and technology usage, explored sleep deprivation as an alternative factor for motivating multitasking behaviour, and suggested the use of multitasking could reduce performance.

Critical Reflections

The authors have demonstrated several uses of both quantitative and qualitative methods with an in situ observational study to justify their work. Although they are careful to measure sleep deprivation by deriving it from the difference of sleep time between school days and free days, the number of hours were mostly self-reported. This may be an inaccurate measure as they have not considered sleep quality that may also contribute to being mentally fatigue or the lack of focus. In fact, the researchers also reported that students were sleeping in on weekends, thus having longer hours of sleep which may affect the difference of hours for the measure of sleep deprivation. This may result in a larger difference of hours accounted for that may question the construct validity of the study.

In addition, in the logging of computer activity, the researchers used Kidlogger to record the durations spent on different application and idle time of computer use were excluded. However, the times of when the students take a break or multitasking physically such as writing notes by hand thus, leaving their computer screen active was not considered. This could affect the quality of the results as students may still be multitasking in other activities that was not recorded. It would be helpful to have a kind of monitoring that is like looking over the shoulder of the participant. Even though it might penetrate the privacy and confidentiality of the user, it can make sure that the participant was indeed multitasking and not randomly browsing through windows due to fatigue or inattention.

Moreover, they claimed that a shorter span of focus duration is associated with higher distractibility. Despite their claim that using Facebook could provide a mental break as implying the students' own choice to switch tasks, the study did not investigate whether the students switched tasks because of ongoing notifications or messages on their Facebook that led them to switching tasks. Also, they claimed that social media was a lightweight activity and participants have mentioned Facebook being used to assist their schoolwork. The social media platform then may not be suitable for the measure of multitask but a measure of switching between subtasks. Rather than social media activities, they could instead consider entertainment activities such as listening to music, watching videos online, and playing games for the secondary task.

In general, the structure of the article was clear and the research questions was well-described. It is suggested that the construct measures may not support enough validity in terms of sleep deprivation, multitasking with use of logs, and the secondary task participants were engaged in.

Future Work

In future work, there can be considerations in three aspects which are on sleep measures, academic performance, and context.

Firstly, studies on how sleep deprivation can be measured should be worked on for higher validity and reliability. In terms of quantitative measures, research can be done in measuring sleep activity with equipment for different types of sleep in circadian rhythms of rapid eye movement (REM) and non-REM to measure sleep quality. Other self-reported measures of quality of sleep could also be used such as using Likert scales for how well participants have slept. By having further research on measuring sleep quality, sleep deprivation can be measured better to give more accurate results for work on sleep deprivation as both a cause and effect of technology use.

Secondly, the factors of students' academic performances can be further explored. There may be a difference between social media and other activities being carried out by the students that are associated with academic performance. By further work into this area, the activity with the most negative impact on academic performance can be curbed. Also, it can give an insight on how different multitasking activities can affect user's performance with varying cognitive load.

Lastly, future work can extend the research to a broader context outside of college students to explore the relationship between technology use and sleeping patterns. A research on people with different occupations may have an impact on the technology use due to the nature of the work. People with different occupations may also have a different level of stress and uses social media differently compared to college students. This can indicate the impact of sleeping pattern on technology use across people of different backgrounds and thus give designers an insight for interfaces based on their target audience.

Conclusion

In conclusion, the article has investigated the effects between sleep debt, multitasking in social media, and emotions of college students. Overall, the authors were more interested in investigating the impact on academic performances of students resulted from multitasking compared to the performance of completing different tasks itself. Since the study has been published, work (Lau, 2017) has been done to investigate the type of tasks students may engage in and suggested that social media was negatively impacting the students' academic performance. Thus, multitasking may pose a threat in performance instead of being a break off tasks and should be considered with care by designers in technology.

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Critical Review of C.J. Hutto, Sarita Yardi, and Eric Gilbert. 2013. A Longitudinal Study of Follow Predictors on Twitter. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '13). ACM, New York, NY, USA, 821-830.

The article written by Hutton, Yardi and Gilbert (2013) titled "A Longitudinal Study of Follow Predictors on Twitter" examined three main factors in terms of social behaviour, message content, and network topology that could lead to an increase in followers on Twitter by a study across time. The authors claimed this is the first time all three factors derived from social and network theories was studied within a single paper. From their findings, they found that all three factors can be predictors of growth and that the impact of content and behaviour are relative to the network structure.

In this review, contributions of the article towards social networking and limitations about the article will be discussed. The review will also suggest novel aspects in which further research can be done in the field of human-computer interaction with respect to the issues raised.

Field Contribution

Using a Twitter API known as Tweepy, the researchers were able to capture multiple snapshots of a sample of users. The snapshots with a time interval provides an insight to the growth of followers which are considered the gain of social capital a user holds. This social capital is indirectly linked to resources tied to a network of relationships that could possibly provide benefits such as information, organizing groups, relationships, mental wellbeing, and job opportunities (Wellman et al., 2003; Ellison, Steinfield and Clampe, 2007). Putnam (2000, cited by Ellison, Steinfield and Clampe, 2007) defined the gain of social capital between groups as bridging while the maintenance of close ties is known as bonding. Using social networking networks such as Facebook (Ellison, Steinfield and Clampe,2007) and Twitter (Hutto, Yardi and Gilbert, 2013), people can form new relationships and maintain existing ties. In fact, many new relationships formed online can lead to face-to-face interaction (Ellison, Steinfield and Clampe, 2007) that can result in stronger social ties to gain the benefits of having social capital. Using Twitter as a social networking platform, the paper contributed different predictors of gaining and retaining such social capital.

Moreover, the paper discussed about different types of communication on Twitter that focuses on the content. In fact, Hutton, Yardi and Gilbert (2013) found an association between the channel of communication and the source with the growth of followers. To strengthen existing bonds, directed communication and messages with negative sentiment can promote the follower to provide emotional support to the user. As the platform allows other followers of that follower to be able to see the interaction, it can also bridge a bond through triadic closure, where the relationship becomes mutual. However, they emphasised that in forming new ties, negative content should be avoided as people may feel uncomfortable not knowing the person enough. By having a complete profile description and regularly providing informational content, the user then can gain trustworthiness and attractiveness to grow their audience. In fact, later published papers by Mueller and Stumme (2017) found that even with a name in the name field could lead to higher follower counts. Thus, it can be suggested that the paper contributed factors that could predict higher social capital on Twitter that could be used in social media management tools to promote brands or products.

Critical Reflections

Compared to previous papers, the article reflected social networking sites as a community building site as a focus on content. A previously published paper (Kwak et al., 2010) has mentioned Twitter as not just a social network but also as an information site. However, the current research

focus on the social networking aspect and placed informativeness as only one of the factors of follower growth. By sharing content, users can gain followers that contribute to expanding their social network. As people have a preference to novel information and in a text-based environment, linguistic cues of sophisticated words can induce the behaviour of users to engage in a tweet. This brings Twitter to become a network linking site with focus to content creation unlike Facebook that focus on building and maintaining relationships (Ellision, Steinfield and Lampe, 2007). The author suggested using Twitter leads to bringing people of similar interest together also known as homophily, and people who are content sharers will possibly gain more followers because as the paper mentioned, those who are popular will become even more popular. However, as the study did not distinguish users into different groups based on sectors or interest, their argument cannot be truly supported because there might be differences between regular users and accounts of organizations that focus on providing information. This may yield different results if users are categorized in terms of other variables such as offline popularity of the user or the account being representative of an organization.

In addition, the authors used a quantitative longitudinal study that helped to describe the associations and relied on speculations to explain their study. It might be an insufficient amount of evidence to explain the causal inferences based on theoretical implications due to the generalization of the measure constructs. In fact, they have quite a few measures just for one factor of audience growth. For example, the follower growth was only taken between two points in time that was at the start and end of capturing the snapshots. The study did not examine if there was a continuous growth of followers. As anyone can create an account on Twitter, the authenticity of followers were also not analysed in which the sudden growth of users could be caused by follow bots. Besides the measurement of follower growth, they measured the rate and volume of tweets as well as the communication channel just for investigating social behaviour. This can cause a confounding effect as to which subset of measures is affecting the results. In terms of conducting a mixed quantitative and qualitative study, different types of users can be identified including their patterns and behaviours exhibited when tweeting. This can also explain what kinds of self-marketing strategies they might have used to gain more followers and benefits that they have obtained. Thus, having a mixed methods research design can probably strengthen the justifications they made and lessen confounding effects.

Future Work

Based on the papers surrounding the topic and the use of Twitter, studies were mostly based tweets in the English language (Ellison, Steinfield, and Clampe, 2007; Hutto, Yardi, and Gilbert, 2013; Kwak et al., 2010). Future work can consider having cross-cultural studies incorporating tweets of other languages and geological locations that indicates the networking topology factor. Considering cultural backgrounds influence how social networks can be formed, it would be interesting to investigate different user patterns and behaviours in a different context.

Additionally, further studies can be conducted into identifying the causes of users being followed or less followed. From the papers that was studied, most of them are statistically inclined and do not show much evidence of why the phenomena of gaining followers occur based on these different factors. Although technology advances rapidly, how society behaves does not change (Wellman et al., 2003). Besides Twitter, studies investigating causes of behaviour can take place in other context of social media or tools in building social capital through bonding or bridging capital.

Moreover, behaviour of how people work across one communication tool to another can be investigated. Besides Twitter, a cross-platform study with different social networking tools would benefit researchers to understand the switches between different networks and boundaries built between the networks, including the overlap of social and spatial aspects of these computer-mediated

communication tools (Wellman et al., 2003). Due to the bi-directional transformation of relationships between those formed online and offline (Ellison, Steinfield, and Clampe, 2007), cross-platform studies would perhaps draw a line of when a relationship gets from offline to online and vice versa.

Conclusion

Generally, the authors of the article have raised important discussions surrounding social networks in computer-mediated systems. The article demonstrated the influence of predictors in increasing social capital through the three main factors of content, social behaviour, and network structure. They further suggested that a social media platform is deeply influenced by the creation of content that strives social connections. However, it would be better for the study to take out confounding variables such as of those offline and to take a mixed methods approach on explaining how the predictors can influence follower growth. Future studies can benefit from cross-cultural and cross-platform researches to understand how social capital is built and maintained with the identification of direct causal influences would develop better social networking systems.

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