

Celebrating Everyday Success: Improving Engagement and Motivation using a System for Recording Daily Highlights

Daniel Avrahami
FXPAL
Palo Alto, CA, USA
daniel@fxpal.com

Kristin Williams
Carnegie Mellon University
Pittsburgh, PA, USA
kmwillia@andrew.cmu.edu

Matthew L. Lee
FXPAL
Palo Alto, CA, USA
mattlee@fxpal.com

Nami Tokunaga
Fuji Xerox
Yokohama, Japan
nami.tokunaga@fujixerox.co.jp

Yulius Tjahjadi
FXPAL
Palo Alto, CA, USA
yulius@fxpal.com

Jennifer Marlow
FXPAL
Palo Alto, CA, USA
marlow@fxpal.com

ABSTRACT

The demands of daily work offer few opportunities for workers to take stock of their own progress, big or small, which can lead to lower motivation, engagement, and higher risk of burnout. We present Highlight Matome, a personal online tool that encourages workers to quickly record and rank a single work highlight each day, helping them gain awareness of their own successes. We describe results from a field experiment investigating our tool's effectiveness for improving workers' engagement, perceptions, and affect. Thirty-three knowledge workers in Japan and the U.S. used Highlight Matome for six weeks. Our results show that using our tool for less than one minute each day significantly increased measures of work engagement, dedication, and positivity. A qualitative analysis of the highlights offers a window into participants' emotions and perceptions. We discuss implications for theories of inner work life and worker well-being.

Author Keywords

knowledge workers; well-being; work engagement.

CCS Concepts

•**Human-centered computing** → **Human computer interaction (HCI)**; *Interactive systems and tools*;

INTRODUCTION

Achieving and recognizing one's own progress and success is a critical ingredient for a positive outlook, motivation, engagement, and a sense of purpose. Conversely, neglecting to recognize progress and accomplishments can lead to lower morale and motivation, higher stress, and a higher risk of burnout. Yet, the demands of daily work offer

few opportunities for capturing and recognizing personal accomplishments, big or small.

In a diary study exploring what influences inner work life (emotions, perceptions, and motivations workers have towards their work), Amabile & Kramer found that a worker's best days are distinguished by a sense of making progress in their work [1]. They claim when workers have a more positive inner work life, they do better work, are more intrinsically motivated to do good work, approach their work with more creativity, and have better well-being.

However, in the workplace, focus is placed primarily on tasks that remain to be done rather than those that were accomplished. In fact, work, once completed, can be easily forgotten, displaced instead by an endless queue of new tasks. In collaborative work, common for knowledge workers, the needs of the team emphasize a constant forward outlook. Consider, for example, the "Stand-up Meeting", a common practice in development teams. These meetings involve team members reporting on tasks completed and tasks remaining, but are focused mostly on resolving barriers to move forward. This forward-oriented mindset can make recognizing progress elusive. Instead, we propose that providing workers with daily opportunities—even brief ones—to record and evaluate positive highlights from their day can bring about significant positive outcomes to workplace well-being.

In this paper, we present a personal online tool called Highlight Matome (Japanese for "Summary") for encouraging workers to consider positive progress by recording daily work highlights. We evaluated our tool in a six-week between-subjects study with 33 knowledge workers in Japan and the U.S. We compared users of our tool to participants in a Control condition. Participants who used Highlight Matome recorded nearly 900 daily highlights, spending approximately 30 seconds a day. Our results show that using our tool resulted in significant increases in worker engagement, dedication, and positive affect, and reduction in negative affect compared to the Control condition. Analyses of the contents of recorded highlights revealed aspects of

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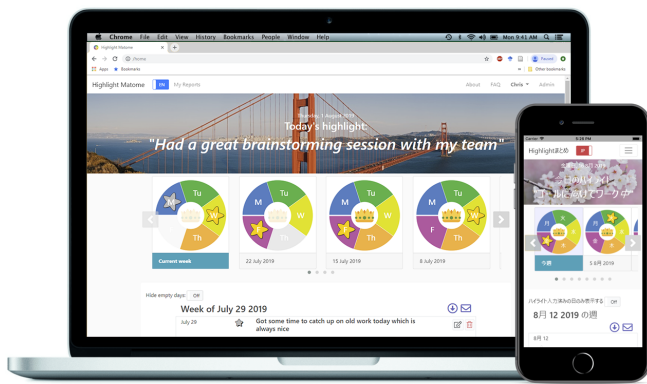


Figure 1. Highlight Matome is an online tool for recording daily work highlights, supporting English and Japanese languages.

participants' inner work life including engagement, positive affect, and a favorable perception of their work environment.

This work makes the following contributions: 1) a novel online system for daily recording and ranking of work highlights, 2) a field experiment in Japan and the U.S. showing empirical evidence that daily recording of highlights can yield measurable gains in inner work life, 3) a content analysis of nearly 900 English and Japanese highlights, 4) Evidence extending theories of inner work life and worker well-being.

RELATED WORK

We review prior work on recognizing progress, inner work life and its impacts, journaling and other tools to support reflection.

Progress and Inner Work Life

In their work, Amabile & Kramer claim that meaningful progress promotes an improved inner work life [1]. In a diary study of 238 workers, they explored both how inner work life—the emotions, perceptions, and motivations workers have towards their work—correlates with worker performance and how organizations influence their employees' inner work life. Amabile & Kramer argue that the everyday work events substantially impact work life, and employees have better work life when they or their companies recognize the impact of work events. Further, they argue that when workers have a more positive inner work life, they do better work, are more intrinsically motivated to do good work, approach their work with more creativity, and have better well-being [1].

Progress consists of the daily work events that get a worker closer to meeting their job's goals. When workers experience and are more aware of their progress, they are said to have a better positive affect, perceive their work environment as supportive, are more intrinsically motivated, and can find their work more meaningful, a sense of pride, achievement, and reaching their potential in doing good work [1, 33]. Identifying progress can be done by segmenting the workday's continuous activity into discrete, goal-directed events that they then interpret from their individual positions, plans, history, and expectations to generate meaning [54].

Impacts of Inner Work Life

Work engagement is a positive, work-related, affective-motivational state of mind characterized by vigor, dedication, and absorption [47]. It is a construct related to motivation. A highly engaged worker is highly energetic and feels dedicated to their work. According to a Gallup study, highly engaged employees tend to be more productive, leading to better business outcomes [19]. In the absence of progress or meaningfulness, workers can experience low work engagement, or even worse, burnout. Low engagement can impact organizations including disrupting relationships with colleagues [36] and increasing absenteeism, worker turnover [12, 36]. In burnout, workers can experience emotional exhaustion, cynicism, psychological distancing from one's work, and a sense of ineffectiveness [36], sometimes spilling over to their personal lives such as marital problems or drug and alcohol abuse [35].

Schaufeli & Bakker [45] developed an integrative model of motivation where work engagement is a psychological state that mediates the impact of job resources and personal resources on organizational outcomes. This model is based on the Job Demands-Resource (JD-R) model [5] that predicts prolonged exposure to high job demands [12] coupled with low resources will lead to burnout. Job resources can mitigate the negative impact of high job demands by helping workers cope [3]. Key job resources are the material or social resources perceived to be available in the work environment [3, 4, 26]. Perceptions of the work environment were found to be more positive when workers experienced a sense of progress [1]. Focusing on positive perceptions of the resources available in the work environment can improve a worker's self-efficacy – the confidence to overcome work challenges [6, 43].

Positive affect has been linked to creativity [2], increased intrinsic motivation, and responsible work behavior [23]. Positive and negative affect at work can also carry over into workers' personal lives [25]. When workers are more aware of goals they have successfully met, the match between their expectations and perceptions of their work can help them to feel more positive [1]. The Broaden-and-Build theory argues that people who are coached to focus on appraising events positively are able to self-generate more positive emotions [16, 18] and are better able to broaden their attention to think more creatively, problem-solve better, and develop better interpersonal relationships through social openness [18].

Supporting Well-Being and Progress

One way to develop an awareness of progress is by journaling. By creating a structure for experienced events, authors write to develop a sensible story out of those events [29]. Improvements in well-being have been linked to journaling regardless whether the author is writing about their best possible self or traumatizing events [41, 29]. These benefits have been reported for college students adapting to their first year, patients undergoing therapy for trauma, and people coping with unemployment [50]. Writing about positive emotional experiences (even briefly as little as two minutes a day) has been linked to better health outcomes [8, 9]. A study on journaling found that participants who were instructed to

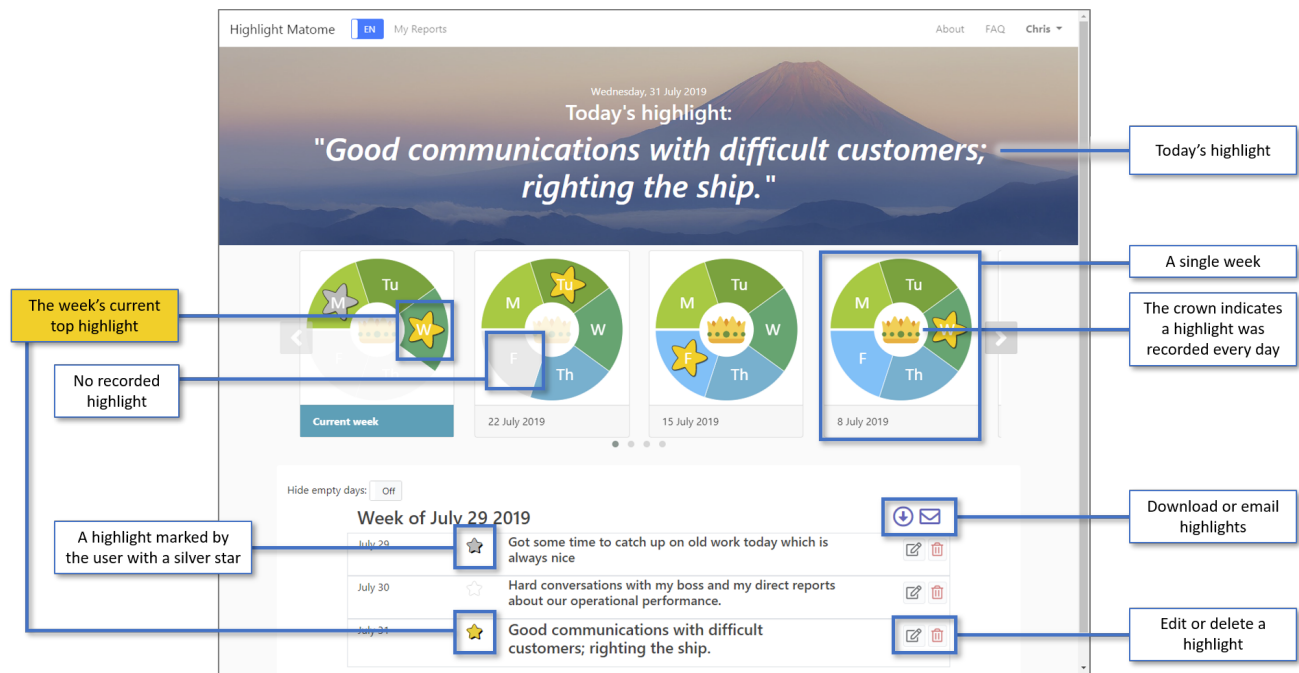


Figure 2. The Highlight Matome dashboard. Current and past weeks are visualized. Top weekly highlights marked by a gold star.

write about themselves as working hard and meeting their goals reported greater positive affect than those in other conditions [38]. We draw on these theories and techniques, applying them in the context of the workplace.

Tools for Supporting Reflection and Motivation

A number of approaches and systems have been developed that aim to improve the performance and well-being of users in similar ways. Several prior systems offered mood tracking, emotional logging, and reflection [21, 20, 42, 40, 22, 32, 31]. These systems help users through a behavior change program, or improve performance by supporting reflection. Hollis et al. suggest that emotional logging is beneficial for supporting users trying to eliminate a bad behavior [21].

Recently, several conversational systems were proposed for guiding workers through reflection. Williams et al. [53] presented a conversational agent for helping workers detach from work at the end of the workday and reattach at the beginning of the next day. The Robota system [30] examined the differences between voice and chat modalities for workplace reflection. Highlight Matome draws upon these prior systems to enable workers to log their tasks, but deliberately avoids asking about plans to promote a positive awareness of progress.

In our research, we aim to answer the following questions:

- RQ1: Can increasing awareness of progress through daily recording of work highlights positively impact workers' inner work life?
- RQ2: How, if at all, do facets of Inner Work Life manifest in knowledge workers' daily work highlights?

HIGHLIGHT MATOME

We designed and implemented "Highlight Matome" (Matome, meaning "Summary" in Japanese), an online tool designed to help workers maintain or develop a positive sense of their work progress and contributions by recording and ranking a single work highlight every day. Highlight Matome currently works in Japanese and English. A paper-prototype pilot, recommendations from [34], and guidelines from [11] led to a set of key design objectives:

Daily interaction should be brief: To sustain engagement over time and avoid overburdening users, the process of recording a daily highlight should not in itself become "work".

Highlight entries should be open-ended: Each worker will have their own idea of what a highlight is for them. This breadth should be supported by the tool.

Recording a highlight should not be required, and absence of a highlight should not be penalized: Some workdays just do not have a highlight (e.g., a worker may consider a day full of meetings to have no highlights).

Encourage contemplation: The tool should encourage workers to think about and evaluate their highlights.

Design for private use: Our tool should allow workers to record their highlights freely, without having to manage impressions of themselves by others [37]. Since workers may be reluctant to record highlights if they knew that peers or managers can read them, we design for private use.

Provide near-term value: In addition to expected long term benefits, the tool should offer near-term value to encourage use. For example, make writing progress reports easier.

Figure 3 consists of two screenshots of a web application interface. Screenshot (a) shows a dialog box titled 'Work highlight for Wednesday, 31 July 2019'. It contains a text input field with the text 'Good communications with difficult customers; righting the ship.' and a smaller text input field labeled 'Details (optional)'. At the bottom are 'Cancel' and 'Next' buttons. Screenshot (b) shows a dialog box titled 'Which of these two work highlights is a bigger highlight?'. It contains two buttons: one with a gold star icon and the text 'Good communications with difficult customers; righting the ship.', and another with a silver star icon and the text 'Hard conversations with my boss and my direct reports about our operational performance.' At the bottom are 'Cancel' and 'Update' buttons.

Figure 3. Composing a daily work highlight (top). Comparing the new highlight to the week's current top highlight (bottom).

We now describe the design of Highlight Matome in detail:

Recording a single daily highlight

At the core of Highlight Matome is a worker's ability to record a single daily work highlight, and provide additional details if desired. Following the breadth of highlights that we observed in a short paper-prototype trial, we designed the tool to keep the notion of a work highlight entirely open-ended. As shown in the dialog in Figure 3a, the tool imposes no constraints on what the user can or should write (aside from the suggestion of a brief description through the use of a single-line text box). The user can record a highlight for the current day (or a past day) at any point. Our system sends an optional email reminder if no highlight was recorded for the day (user customized, sent by default towards the end of the day, at 4:30pm, when the user is likely to know what they had accomplished that day).

Ranking a top weekly highlight

A novel aspect of Highlight Matome is a feature that allows one of a worker's weekly highlights to "bubble to the top" as a top weekly highlight. After recording a first highlight for the week (e.g., on Monday), that highlight is marked with a gold star as the current top weekly highlight. When the user records another highlight for the week (e.g., on Tuesday), they are presented with their current top weekly highlight and the new highlight and are asked, "Which of these two work highlights is a bigger highlight?" The two highlights are presented as buttons (see Figure 3b). If the worker selects the new highlight as the "bigger" highlight, it becomes the current top highlight and is given the gold star (the user can later change their mind by editing the highlight). At the end of the week, a single highlight will have become that week's top highlight. In addition to being used for composing reports, this daily evaluation of highlights is important for expanding the highlight-recording process to include not only "generation", but also contemplation and reflection. At the end of each workweek (at 6pm on a Friday), users receive an

email summarizing their highlights for the week, emphasizing their top weekly highlight.

We designed the process of composing and ranking a highlight to take very little time – our stated goal was less than one minute each day. We believe this is a most critical design objective; Highlight Matome must not become effortful work.

Silver stars

In our pilot study, two participants said that they had several important highlights in the same week and wished to award stars to these highlights as well. We thus allow users to award silver stars to any of their highlights (by clicking the empty star icon next to a highlight). There are no restrictions on the number of highlights that can receive a silver star. Stars (both gold and silver) can further help the user filter their highlights in the reports page.

A visual dashboard

All highlights are represented graphically in a dashboard. The dashboard includes a visualization for each week (see Figure 2) with a slot for each workday. Each day with a highlight is shown as "active" and stars are shown as well. If all five days in the week have a highlight, the crown in the center of the week becomes visible (Figure 2, right).

Currently, Highlight Matome will only accept highlights for Monday through Friday, but not for the weekend – when a user visits the site on Saturday or Sunday, they are greeted by the message: "We hope you are enjoying your weekend. See you Monday!" One important reason for not including Saturday and Sunday in Highlight Matome is that, since those are not common workdays for our target users, it will result in a dashboard littered with two days without highlights for most weeks. This might diminish the positive impact we expect of seeing a week full of highlights on one hand and may even create a false sense that the user is expected to have work highlights on the weekend.

Reports

Finally, a potential benefit of recording highlights is in helping workers gather data for progress reports ([34] cite this as a top challenge for progress reporting). For example, at our parent company, employees submit activity reports weekly, monthly, and every six months. Highlight Matome's "My Reports" page allows the worker to read through their highlights from the past week, 2-weeks, month, 2-months, or all highlights, and filter only starred highlights (gold and silver stars). The worker can have a report emailed to them by the site.

Implementation

Highlight Matome was implemented in Python using Flask [13] and SQLAlchemy database interface [51]. Jinja2 [24] was used for web-page templating. We used Bootstrap [7] for responsive rendering, allowing Highlight Matome to be used on both computers and mobile devices (as illustrated in Figure 1). For supporting both English and Japanese, we used Flask-Babel [14]. Our dashboard visualizations use a hierarchical SVG structure, allowing simple replacement of graphical elements with the same underlying code (this

will allow us to easily offer different designs in the future, important for supporting a broad set of users [10]).

FIELD EXPERIMENT

To evaluate Highlight Matome's potential at helping knowledge workers gain better awareness of their daily accomplishments, and its effectiveness for improving workers' engagement, motivation, and affect, we conducted a 6-week in-situ field experiment. In order to control for the likely effects that result from simply being in a study and responding to surveys, we used a control condition in a between-subjects design. The study was conducted with knowledge workers in Japan and the United States to provide a more robust evaluation across two different work cultures.

Method

We conducted a six-week between-subjects controlled experiment with two conditions: Highlight Matome and Control. Participants completed a baseline Pre-Study survey, and then a survey at the end of each week. Only participants in the Highlight Matome condition used our tool for the duration of the study (six 5-day workweeks). The study duration was chosen to be sufficiently long to allow any potential effects to take place (and, potentially, wear off). We deployed our field experiment simultaneously in Japan and the U.S. to gain a broader understanding of our tool's potential.

Data Collection

We collected both self-reported data through surveys (from participants in both conditions), as well as data from Highlight Matome (from participants in the Highlight Matome condition). All surveys were created in Japanese and English.

Highlight Matome data

We collected measures of participants' interaction when composing highlights with our tool. We collect the time and date when a highlight is posted, as well as the highlight's contents. We also log the time a user took to compose and rank the highlight. Finally, we record whether the highlight was edited and when.

Pre-study, mid-study, and post-study surveys

We collected self-reported data from participants just before the study, at the mid-point, and at the end of the study. The Pre-study survey included demographics as well as self-reported ratings of Work Engagement, Self-Efficacy, Positive and Negative Affect, Perceptions and Appraisal of Work Environment, Job Meaningfulness, Perceptions of Progress, and Active Reflection. We describe these in further details in the "Measures" section below and in Appendix A.

To answer our research questions and investigate *changes* caused by using our tool, in our Mid-study and Post-study surveys, participants provided ratings relative to the previous survey on 7-point scales ranging from 'A lot less' to 'A lot more' with 'About the same' as the neutral point. This process allowed us to avoid issues with floor or ceiling effects that could result from responses to the Pre-study survey (e.g., consider the inability to measure improvement for a participant who rated themselves high before the start of the study).

Finally, the post-study survey further asked participants in the Highlight Matome condition for their reactions to using the tool, and open-ended questions to all participants about any major changes to their jobs during the study.

Weekly surveys

In addition to our key three surveys, at the end of each week, participants identified days absent, days worked from home, or any unusual events that could have impacted the participant's work, productivity, or stress.

Measures

To test our first research question (RQ1), the following scales were used to collect self-reports from participants in the Pre-study, Mid-study, and Post-study surveys. As described above, in the Mid-study and Post-study surveys, participants reported change for each of the survey's items. We introduce each scale below (additional details are in Appendix A).

Work Engagement and Dedication

To measure work engagement, we used the *Utrecht Work Engagement Scale* (UWES), specifically its Ultra Short Form version (UWES-3) [48, 49]. We chose the UWES-3 for its brevity and because it has been validated in the US and Japanese contexts. With Highlight Matome closely aligned with the dedication dimension from the Work Engagement scale, we included the three dedication items from the 9-item UWES (UWES-9) [46], such as "When I get up in the morning, I feel like going to work."

Workplace Self-efficacy

To examine changes in workers' confidence in their ability to overcome challenges at work, we adapted the *General Self-Efficacy Scale Short Form* (GSE-6) [43]. For example, "At work, how confident are you that you can deal efficiently with unexpected events?" Participants rated their confidence for the six items on a scale from 0 (Not at all confident) to 10 (Completely confident). In the Mid- and Post-study surveys, participants rated the relative change in their confidence on the 7-point scale ranging from "A lot less" to "A lot more".

Workplace Affect (Positive and Negative)

To test whether awareness of progress can lead to positive affect, which, in turn, translates to positive impressions of the work environment and job satisfaction, we used the *International Positive Affect and Negative Affect Scale-Short Form* (I-PANAS-SF) [28, 52], as it was validated in both the US and Japan. We adapted the prompt to the workplace: e.g., "Thinking about yourself and how you normally feel at work, to what extent do you generally feel inspired?" Participants provided ratings for each emotion on a 5-point scale from "Very slightly or not at all" to "Extremely."

Perceptions and Appraisal of Work Environment

We included measures of participants' perception and appraisal of their workplace environment (PAWE for short). The survey questions were derived from prior research on Job Characteristics Theory and Job-Demands Resource Theory [39, 1, 44, 27]. Specifically, they assess characteristics of the worker's job such as autonomy and opportunities for development as well as supportive relationships with

co-workers or supervisors (e.g., "How much can you count on your colleagues for help and support, when needed?").

Progress, Reflection and Job Meaningfulness

Finally, we included 2 items about perceptions of making progress at work, based on [1]. We included 3 items asking about participants' active reflection of what they did at work and their plans, and included a single item asking participants to rate the statement "I have a good sense of what makes my job meaningful." All items in these categories were rated on a 7-point scale from 1 (Not at all) to 7 (Completely).

Procedure

Participants in the U.S. were recruited through both snowball sampling and by advertising the study through e-mail, social media, and on Craigslist. Participants in Japan were recruited from within our parent organization – a large technology company in Yokohama. All participants had to meet the following criteria: 1) fulfilled the definition of a knowledge worker on Wikipedia; 2) at their current job for at least one year; and 3) no planned extended absences from work during the study. Participants were randomly assigned to Control and Matome conditions such that 25% of participants were in the Control condition. This split allowed us to get interaction data and highlights content from the majority of participants.

On the Friday before the study, all participants completed the Pre-study survey. Then on Monday, participants in the Highlight Matome condition received instructions for creating an account and recording a first highlight. Because of firewall restrictions, we deployed two identical Highlight Matome servers in Japan and in the U.S.

When creating their account, participants provided their explicit consent to the data collection, as well as an additional *optional* permission to share their (anonymized) highlights in this paper. At the end of each Friday, participants in both conditions received an email with a link to a survey – the surveys on the 3rd and 6th weeks included Mid-study and Post-study survey questions. After completing the final survey, U.S.-based participants received a \$75 gift card via email. Japan-based participants received a \$25 customized mug (corporate policy prevented awarding these participants with a gift card or payment).

We note that due to a national week-long holiday in Japan, the study started in Japan a week early such that the holiday occurred after three weeks of the study. Thus, the second half of the study was synchronized between Japan and the U.S. and finished on the same day.

Participants

Forty-four knowledge workers participated in the study: 20 in Japan and 24 in the U.S. Eleven of the participants (25% from each locale) were randomly assigned into the control condition (5 in Japan and 6 in the U.S.). 3 additional participants started the study but were later dropped after failing to complete multiple surveys or recording nonsense text into the tool.

There were 22 women (7 in Japan and 15 in the U.S.) and 22 men (13 in Japan and 9 in the U.S.), participants' job roles included Computer Engineering, Research, Multimedia,

Administration, Education, and Healthcare. More than half of participants (23) were in engineering roles. 22 of the participants indicated an age between 25 and 34. Four were between 18-24, eight were between 35-44, nine were between 45-54, and one above 55 years old. All participants indicated that they are required to report their work, with 29 of the participants (66%) indicating they report their work weekly.

To verify that the random assignment of participants into conditions did not unintentionally produce groups that already differed along the outcome measures, we compared Pre-study responses by Condition, Locale (US v JP) and the 2-way interaction were independent variables. The models showed no significant differences between the conditions (p between 0.12 and 0.87). There was, however, a small difference by Locale on the Reflection measure, with U.S.-based participants rating higher ($M=14.6$ v $M=12.1$; $F[1,54]=4.9$; $p=.03$). An important difference between the locales is that all Japan-based participants came from a single organization, while the U.S.-based cohort did not. Response rate to the surveys was 98% (303/308 surveys completed by the 44 participants).

The full details of this analysis appear in Appendix B.

RESULTS

We begin by providing an overview of participants' interaction with Highlight Matome. We then present a statistical comparison between the Control and Highlight Matome conditions, demonstrating the effect of our tool. We then present an analysis of the contents of users' highlights, and describe users' reactions to using the tool.

Overview

894 highlights were recorded by the 33 users in the Highlight Matome condition during the study's six weeks. This represents 96% of the days these users worked (there were 52 days where participants indicated in the weekly survey that they were *Absent* from work but not *Working from Home*). In 68% of cases, a day's highlight was recorded on the same day, and in 18% recorded the day after. 78% of Friday highlights were recorded on Friday rather than being left until after the weekend. 60% of highlights were recorded between the hours of 4pm and 7pm (recall that by default users receive an email reminder to log a highlight at 4:30pm).

One of our key design objective was for Highlight Matome to demand minimal daily effort with the system. The data show that users spent a median of 32 seconds composing and ranking a highlight each day ($M=51.8$, $SD=64.1$). There were significant individual differences among participants in the average time spent composing messages, ranging from 11 seconds to 146 seconds. There was no significant difference in time spent composing highlights between locales ($F[1,32]=0.3$; $p=0.6$). Japanese highlights had a median length of 19 characters ($Min=2$, $Max=189$) and English highlights had a median length of 55 characters ($Min=5$, $Max=406$).

The data show that after week 2, users wrote shorter highlights ($F[5,850]=21.4$; $p<.001$) than in the first two weeks (there was no difference between weeks 3, 4, 5 and 6). They also spent less time composing highlights ($F[5,850]=23.3$; $p<.001$). It is

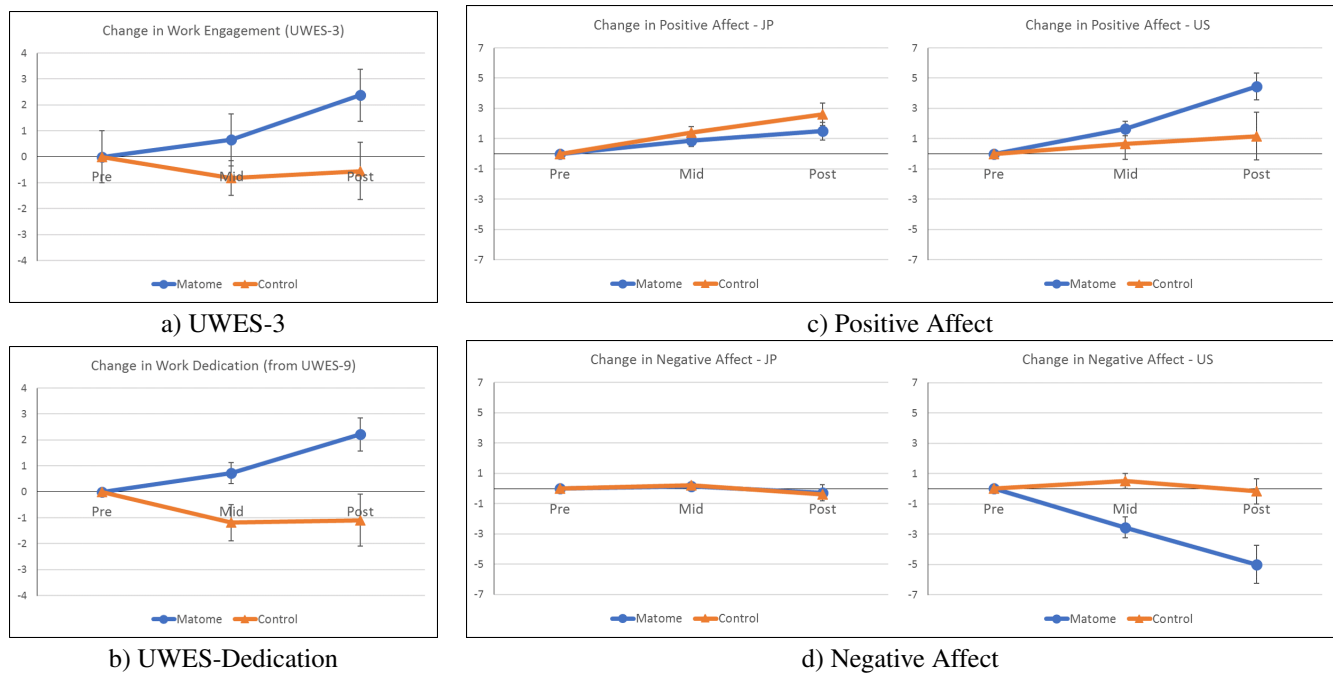


Figure 4. Changes in Worker Engagement, Dedication, Positive affect, and Negative affect. Comparisons between Highlight Matome and Control conditions

likely that within two weeks participants "got in the groove" of the daily routine of recording and ranking highlights.

Highlight Matome vs. Control Condition

We compare changes in the 9 outcome measures between the conditions as follows: The change reported by participants for each measure in the Mid-study survey and in the Post-study survey (*e.g.*, change in Worker Engagement ratings) are modeled using a mixed-model analysis. The baseline value reported in the Pre-study survey is used as a covariate (and change value for the Pre-study survey is set to zero). The Condition (Matome v Control), Locale (US v JP), and Study Stage (Pre v Mid v Post) and the two-way and three-way interactions as Fixed Effects. The ParticipantID is modeled as a random effect, nested within Locale and Condition. The full details of this analysis appear in Appendix C.

Results show differences between the two conditions in 4 of the 9 measures. Change in Work Engagement (UWES-3) was significantly different between the conditions with a significant interaction of Condition by Study Stage ($F[2,79]=3.8; p=.027$), with Highlight Matome users showing an increase in Work Engagement, and Control participants showing on average no change to a slight decrease (Figure 4a). Change was significantly positively correlated with a participant's pre-study rating ($p<.001$).

Change in Worker Dedication (3 items from UWES-9) was similarly different between the conditions with a significant interaction of Condition by Study Stage ($F[2,79]=3.8; p<.01$) as well as a main effect of Condition ($F[1,40]=9.5; p<.01$). As seen in Figure 4b, Highlight Matome users reported an increase in Dedication, while Control participants reported a

slight decrease on average. Change was positively correlated with a participant's pre-study ratings ($p<.001$).

We found no significant differences between the conditions on Self-Efficacy, PAWE (Perception/Appraisal of Work Environment), Active Reflection, Sense of Progress, or Job Meaningfulness. In all cases, ratings changed positively and significantly by Study Stage (likely a result of the weekly surveys) but not differently between the conditions.

We did find significant differences in the change in Positive workplace affect (5 items from I-PANAS-10) with a significant interaction of Condition x Locale x Study Stage ($F[2,79]=3.2; p<.05$). As seen in Figure 4c, there was a significant overall increase in reported positive affect for US-participants who used Highlight Matome, but no overall change for control participants in the US. For JP participants, we see an increase for both Control and Matome participants (although significantly lower than for US-based Matome users).

We find a similar effect on Negative affect (5 items from I-PANAS-10), with a significant 3-way interaction of Locale, Condition, and Study Stage. As seen in Figure 4d, only US-based Matome users experienced a significant overall decrease in negative affect, while all other participants did not experience overall change ($F[2,79]=3.2; p<.05$).

Our results provide an initial answer to our first research question (RQ1), demonstrating that increasing workers' awareness of progress through daily recording of work highlights can have positive impact on engagement, dedication, and affect – key components of workers' inner work lives. Still, change in affect was not expressed by our Japan-based users. We now turn to RQ2, exploring the contents of users'

highlights, looking more closely at how Highlight Matome was used and potential clues as to its effect.

Analyzing the Contents of Highlights

We next present an analysis of the contents of daily highlights. We show that participants used highlights to describe the workday's events, evaluate them, recognize progress, develop a personal narrative of success or limitations, and interpret their work environment's support for getting their job done. We provide evidence of users engaging in event coalescence, sense-making, and focusing on positive appraisals of their work environment.

Content analysis process

We developed a set of deductive codes from the literature relevant to our research questions—sense-making, affect, engagement/motivation, job characteristics, work environment, and progress—as well as inductive codes. After coding and refining our codebook across multiple rounds with a subset of English and Japanese highlights (translated into English), two coders independently coded a test set of 20% of all the English and 20% of the Japanese highlights. Japanese content was translated into English for one coder and coded in its original form by a second coder (a native Japanese speaker). We used the test set to establish inter-rater reliability. Codes with poor conceptual clarity (below Cohen's κ 0.6) (e.g., motivation, task completeness, autonomy) were removed. Our final set of codes had an average Cohen's κ of 0.70 (SD=0.08) across six codes: *work/personal*, *no_highlight*, *descriptive/evaluative*, *positive/negative*, *narrative_chain*, *work_environment*. Multiple codes could be assigned to a highlight. The remaining Japan and US data were coded by the Japanese coder and English-speaking coder, respectively.

Documenting work

As expected, the majority of the highlights (97%) described the participants' work or events related to their job. These work highlights ranged from larger milestones such as "*completed a research project*" (US-P10) to smaller ongoing activities "*continue ed training*" (US-P12). Many highlights also described the worker's impression of an event's quality such as "*Had a conference today and got to meet some new people in my field of work, always lots of fun.*" (US-P21). In a small fraction of cases (3%), participants recorded personal events unrelated to their work. While interesting, we focus the remainder of our analysis on work-related highlights.

Describing what happened

69% of highlights were coded as purely descriptive and 31% included evaluative content (i.e., interpretations or judgments of good or bad). Purely descriptive highlights report work neutrally, such as documenting one or more tasks accomplished or meetings attended. Four out of the 33 participants recorded purely descriptive highlights only. Highlights of routine events commonly had few details, although some participants elaborated on the day's highlight.

Finally had a chance to get a walkthrough and discuss issues with prospective booking software with lead on the project. Explored pro/cons, especially in terms of accessibility and usability... (US-P22)

Several highlights focused on breaks of routine like US-P21's "*no one in office except me*" or when US-P10 took an "*early shift to start/prepare for new client meeting/sales.*"

Making progress

112 instances (13%) of work highlights chained work events together to create a high-level timeline of milestones. Whereas 74% of chained highlights used a neutral tone, 26% synthesized the day's events and interpreted them, such as this highlight coded as *Narrative Chain*, *Evaluative*, and *Positive*:

"Excellent interview today with another prospective PM, AND [sic] I was able to finally get some organization to my personal work efforts." (US-P19)

Some expanded the timeline to show how one event caused another. These narrative chains illustrate the multiple tasks completed or worked on, and characterize ways the worker made progress during the day.

Evaluating the day's highlight as good or bad

31% of the highlights contained evaluative content that characterized an event as positive, negative, or a mix of both. Over half (58% or 155 instances) of these described the day's highlight positively and identified features of participants' jobs that were valuable or meaningful to them. US-P21 wrote about being an effective teacher: "*The highlight of today was just being able to teach the kids something new and to see them enjoy learning.*" Highlights celebrated long-invested effort paying off, like "*success with progress correcting some operational issues that have plagued the company for months.*" (US-P19) They also recognized personal growth. US-P18 reflected on the day to conclude "*I led a meeting today that I want to say was very productive and...I assisted in escalating some issues to the necessary people.*" Highlight Matome successfully supported workers' need to reflect on the workday's problems and come to their own conclusions or plans for their next steps. For example, after working on a bug for days, JP-P15 determined "*the bug was fixed by downgrading all libraries... All bugs in a past version are not always fixed in upgraded versions! I got fooled!*" As participants portrayed positive highlights from the day, they positioned themselves within a narrative of accomplishment.

Still, 61 instances (7% of all highlights) were coded as exclusively negative sentiment, with a larger fraction of highlights with negative sentiment for Japan-based participants (25%) compared to U.S.-based participants (21%). Many of the entries with negative sentiment mentioned work challenges such as "*A student collaborator visited and we considered how to proceed, but handling confidential data is difficult.*" (JP-P2) and "*today was filled with meeting after meeting, no breaks*" (US-P21). In a few cases, participants documented a setback or poor result such as "*Idea getting rejected*" (US-P9), or "*Participated in an impromptu meeting at [E]. I am worried about the difference between the expected value and the deliverable.*" (JP-P2).

Finding supportive resources in the work environment

Job demands-resource (JD-R) theory argues that the work environment can support workers meet job demands by providing necessary material and social resources [3, 4, 26]. In

our data, half of all the highlights mentioned some material or social element of the work environment. For example, JP-P6 wrote, *"Different problems were solved at once by Z's offer that we can borrow Z's team's server...I was very thankful."* Participants juxtaposed time shortages with job demands: *"The client wants their project sooner than possible and we are not anywhere near finished"* (US-P24). We found a small but significant difference between locales, with more frequent mentions of work environment resources by U.S.-based than Japan-based participants (55% vs. 42%; $p < .001$).

Participants usually portrayed social resources, like their coworkers, as supportive. For example, US-P19 said, *"I received a nice note from my coworker. I've really gone the extra mile to cultivate a good working relationship with her. A great moment for a mostly dismal day."* We noted that, while Japan-based participants often mentioned co-workers by name, US-based participants rarely did so. Participants mentioned supervisors much less frequently, most commonly in the context of meetings and feedback (e.g., *"Boss gave praise for work I did on an ongoing project."* (US-P16) but also, *"got chewed out by my CEO due to an angry client."* (US-P24)) Curiously, there were no references to a supervisor by the Japan-based participants. With nearly all highlights that describe the support workers received written using neutral and positive tones, Highlight Matome may have contributed to positive reflections on the work environment.

When there is no highlight to record

In 38 instances (4% of highlights), participants wrote an entry describing the workday as having no particular highlight. The majority of these cases mentioned *"nothing special happened"* (US-P9). In a few other cases, some entries were about simply surviving and reaching the end of the day to leave work. For example, US-P18 wrote *"Today was a pretty mundane day, boring meetings and no free food, I made it out alive"*. It was in these instances that we observed isolated cases of worker cynicism, an antipode to worker engagement. This rarity of signs of feeling "checked out" aligns with our finding of dedication and engagement increasing.

Starred highlights

By design, one highlight each week emerges as a "Top Highlight" and is shown with a gold star. Our data contained 16 additional highlights that were marked with a silver star. We compared length (in characters) and compose time of starred (gold or silver) and non-starred highlights through a mixed model with Week (w1-w6), Locale (JP vs. US) and Starred (Yes v No) as fixed effects as well as the interaction of Starred and Locale. ParticipantID was a random effect. The comparison shows that starred highlights were longer on average ($M=36$ characters vs. $M=28$; $F[1,850]=31.8$; $p < .001$) and users took slightly longer to compose them ($M=36$ seconds vs. $M=31$; $F[1,851]=7.9$; $p < .01$).

Comparing the affect in starred vs. non-starred highlights shows that starred highlights were more likely to be evaluative and with significantly higher positive sentiment on average ($M=.08$ vs. $M=.21$; $F[1,825]=10.7$; $p=.001$). Starred highlights were 45% less likely to contain negative sentiment and 61% more likely to contain positive sentiment.

In the post-study survey, when asked to describe a favorite top highlight and explain why, a common feature of top highlights was relating to other people. For example, JP-P3's favorite was *"Conducted experiments with a junior coworker and was able to work extremely efficiently."* They explained that *"With the help of others, the efficiency of the work went up more than expected, so it was impressive"*. Explaining what made a "top highlight", US-P22 said it *"included a positive connection with a patron or colleague or included praise and recognition for doing good work."* US-P15 said, *"If I felt engaged and energized by it."*

User Reactions to Highlight Matome

Twenty of the participants indicated that they had learned about themselves, their habits, or their work as a result of using Highlight Matome. Common themes raised by participants were increased awareness, the value of keeping records and seeing lists grow, and realizing necessary changes. US-P24 wrote: *"I learned that I give myself less credit than I should."* and US-P17 wrote: *"Thanks to Highlight Matome, I could easily keep track what I have done and what I should continue and plan for the next works in the week."* JP-P8 wrote: *"By trying to verbalize a highlight, I realized that I originally can feel the highlight of the day implicitly."* US-P18 wrote: *"I learned that I need rewards to stay motivated throughout the day."* And US-P22 wrote: *"That I thrive off lists and checking off items."* Several participants described realizing changes they needed to make. JP-P9 wrote: *"I started planning for tomorrow based on what I did today."*, and JP-P10 wrote *"I found I've kept working on similar tasks, then I realized I need to improve my productivity (at work)."*

Asked about the cadence of recording highlights, twenty-five participants considered daily highlight recording just right. US-P20 wrote: *"It can show your accomplishments and show your productivity during a good amount of time. If you fill out weekly status reports, this is a perfect way to keep track of the progress."* US-P13 wrote: *"Capturing the key moment of a day helps progress toward goals."* US-P8 wrote: *"It took such little time to do it that it was fine to do it daily."* And JP-P4 wrote, *"I expected it might be burdensome at the beginning, but I rather feel more benefits with this amount of sentences."* However, 7 participants indicated that daily recording of highlights was too frequent. US-P9, a lab manager, wrote, *"My work is pretty tedious and repetitive so a lot of time it's difficult to come up with a highlight."*

DISCUSSION

We presented results from a deployment of our tool that suggest that brief daily recording of highlights can have significant positive effects on knowledge workers. The comparison to workers in a control condition who completed the same surveys each week gives confidence in the results by allowing us to account for effects of participation in a study, and of increased awareness triggered by the surveys. The deployment in Japan and the U.S. both broadens our findings and raises interesting questions of differences observed. In this section, we discuss the implications of the results for theory, and applications for Highlight Matome beyond the workplace.

Theoretical Implications

Through our controlled field experiment, our study established a causal link between recording and ranking a daily highlight and improvements in aspects of inner work life, specifically the affective-motivational state of work engagement/dedication and positive affect. Specifically, our study measured the impact of introducing daily highlight recording on workers, comparing to a control group. Previous work by Amabile & Kramer [1] used an observational diary-based approach that identified an correlational association between a sense of progress and improved motivation and affect.

Analysis of participants' self-reports and of the contents of highlights shows that workers themselves can develop a sense of progress and improve their own work life by reappraising work events daily, complementing earlier work suggesting that organizations and managers have sole responsibility in facilitating a sense of progress in workers.

In our study, U.S.-based participants experienced significant increases in positive affect and decreases in negative affect. These findings are consistent with the Broaden-and-Build theory [18, 16] and Progress Principle [1], that predict knowledge workers can generate more positive emotions when they focus on positively reappraising past work events. However, the fact that our Japan-based participants did not exhibit the same increase in positive affect warrants further investigation. Unlike earlier work that investigated writing as a method for appraising only extremely negative or positive events [8, 9, 29, 38], Highlight Matome's open-ended prompt – to record a *work highlight* – focuses attention on salient events of the day with a slightly positive connotation. While the majority of participants' highlights were neutral in tone, gains were still experienced. This suggests that workers can still benefit from boosts in affect and engagement without needing to follow an elaborate format as in [1] or be pushed strongly in a positive or negative direction as in [8]. Further, previous work in writing therapy identified causal words or insight words in writing samples as critical sense-making mechanisms [41]. Yet, we find that participants benefited even with minimal structures such as simple lists in *narrative chaining* or when offloaded to the user interface in response to a simple prompt as with purely *descriptive* highlights.

Prior work argued that perception of material and social resources in the work environment can buffer the strain of prolonged exposure to high job demands [3]. In our data, 50% of Highlight Matome entries described the role of these resources in the workplace. While we did not find significant differences in our surveys of participants' perceptions of their work environment, we did find evidence of positive appraisal of the work environment in the highlights' contents. Furthermore, many of the descriptions of the work environment positioned participants in active roles in which they were successfully able to get help from co-workers and supervisors, or secure the materials they needed to get their job done. We find that in reappraising the workday highlight, workers reconstruct a self-narrative in which they were able to seek out resources needed to meet their job's demands. These findings extend research on writing therapy that recommends

prompting participants with narratives about working hard and being successful [29]. Future work should examine how to elicit alternative narratives that position the author as empowered in other important aspects of inner life such as self-efficacy and autonomy.

Supporting Days with 'No Highlights'

While Highlight Matome does not *require* users to enter a daily highlight, users may still feel pressure to do so (in part, due to the daily email reminder). Even though this pressure can, in some cases, motivate users to produce a piece of highlight-worthy work, it can also leave users frustrated, especially if they did not feel in control of their day. Indeed, several users requested in the Post-study survey a mechanism for explicitly indicating a No Highlight. We intend to initially add functionality for users to indicate days absent. We then plan to investigate whether an ability to easily mark a day as 'No Highlight' runs the risk of eliminating the motivating pressure to reflect on the events of the day to find a highlight.

Beyond Work

Our focus has been on addressing knowledge workers' difficulty in recognizing and benefiting from their daily accomplishments. However, the challenge of sustaining progress and recognizing small successes applies beyond the workplace. In future work, we plan to explore the addition of personal progress tracking into Highlight Matome, including ability to import external sensed data into the tool. We further intend to explore applying Highlight Matome in other domains. One area would be supporting users through a behavior change program who require support for sustaining motivation and engagement. Another domain for Highlight Matome may be in supporting student learning. Broad reflection questions can direct thought to a general subject matter, but that specific questions can help bring attention to the process of the user is doing to help them learn from it [15, 17]. Highlight Matome could help students engaged in daily learning become aware of their learning progress.

Limitations

The evaluation results provide evidence for some of Highlight Matome's potential to improve measures of inner work life. However, while we believe that having successfully deployed our tool in both Japan and the U.S. increases the depth of our investigation, all our participants in Japan came from a single organization, while participants in the U.S. did not. In the future, we hope to deploy Highlight Matome with knowledge workers from other organizations in Japan. Our evaluation also lasted six weeks. This may have not been sufficiently long for subtle, second-order effects from manifesting (and expressing in the data). For example, we expect that positivity, dedication, and engagement will lead to a more positive appraisal of the work environment, but that this process takes a longer time. Still, within 6-week, our users established a steady state of daily interaction, and Highlight Matome was able to produce measurable improvements. Finally, the Control condition included fewer participants than the experimental condition.

CONCLUSION

We introduced Highlight Matome, a personal online tool that encourages knowledge workers to quickly record and rank a single work highlight each day to help them gain awareness of their own successes, big or small. Relying on principles from the theory of inner work life, the Job Demands-Resource model and the Broaden-and-Build theory, Highlight Matome aims to improve workers' engagement, motivation, and ultimately productivity and well-being. Results from a deployment in the U.S. and in Japan show that daily interaction with our tool of 32 seconds a day was able to lead to significant gains in worker engagement, dedication, and positivity compared to a control condition. The breadth of topics and sentiments expressed in participants' personal work highlights drives the conclusion of the importance of an open-ended highlight-recording tool for supporting the unique contexts of individual workers.

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