Impact of Providing a Personalized Data Dashboard on Ecological Momentary Assessment Compliance among College Students Who Use Substances: A Pilot Micro-randomized Trial

Stephanie Lanza, Samuel W. Stull, Danny Wang, Sandesh Bhandari, Stephanie T. Lanza

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Stephanie Lanza[1] PhD; Samuel W. Stull[2] MS; Danny Wang[3] MS; Sandesh Bhandari[1] MAS; Stephanie T. Lanza[3] PhD

[1]The Edna Bennett Pierce Prevention Reesarch Center The Pennsylvania State University University Park US
[2]The Edna Bennett Pierce Prevention Reesarch Center Biobehavioral Health Building University Park US
[3]Department of Biobehavioral Health The Pennsylvania State University University Park US

Corresponding Author:
Stephanie Lanza PhD
The Edna Bennett Pierce Prevention Reesarch Center
The Pennsylvania State University
320E Biobehavioral Health Building
University Park
US

Abstract

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Ashley N. Linden-Carmichael, Samuel W. Stull, Danny Wang, Sandesh Bhandari, and Stephanie T. Lanza

The Pennsylvania State University

Short title: Personalized Data Dashboard for Study Compliance

Corresponding author: Ashley Linden-Carmichael, Ph.D., 320E Biobehavioral Health Building, Edna Bennett Pierce Prevention Research Center, College of Health and Human Development, The Pennsylvania State University, University Park, PA, 16802. Phone: (814) 865-7177. Email: ALindenCarmichael@psu.edu. ORCID: 0000-0001-8187-6538; @DrAshleyLC

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Conclusion. Providing a DD may be useful to increase engagement, particularly for researchers aiming to assess health behaviors shortly after a survey prompt is deployed to participants' mobile devices.

Keywords. Ecological momentary assessment; data dashboard; study compliance; college students

Introduction

The landscape of substance use behavior among college-attending young adults (ages ~18 to 25 years) has changed in recent years. During the last 10 years, prevalence of past-month drinking, daily drinking, and heavy episodic drinking (4+/5+ drinks in an occasion for females/males) have declined in this age group, although rates remain high, with 31% of young adults aged 19-30 reporting past two-week heavy episodic drinking(1). Conversely, rates of daily cannabis use (20+ use occasions in the past 30 days) are at all-time highs, with 11% of young adults reporting daily use(1). Pacing with increases in cannabis use in recent years, young adults are also increasingly reporting co-use of alcohol and cannabis use, with approximately one-quarter reporting past-year simultaneous use or use of both substances so that the effects overlap(2). Many young adults experience acute negative consequences related to heavy and frequent alcohol and/or cannabis use, including blacking out, social/interpersonal concerns, or adverse physical effects(3). Moreover, many young adults meet criteria for past-year alcohol use disorder (16.4%) and/or cannabis use disorder (16.5%).(4)

Daily diary and ecological momentary assessment (EMA) designs have become ubiquitous to health researchers assessing fine-grained daily or momentary predictors and outcomes, such as alcohol and cannabis use behavior, as well as for delivering timely intervention content based on participant responses (e.g., mood, social setting(5, 6)). However, they often require participants to initiate action or respond to a prompt. For example, studies deploying intervention content or developing “decision rules” for delivery typically rely heavily on high participant compliance in completing mobile surveys soon after each prompt is sent. In addition, just-in-time interventions may involve detecting and disseminating messages during sensitive time windows: for example, delivering time-sensitive momentary feedback on a participant’s speed of alcohol consumption during the beginning of a drinking episode may rely on the participant self-reporting the amount of alcohol they have consumed thus far and/or their level of perceived impairment. EMA protocols assessing substance use behavior may also rely on participants completing surveys on days when

certain behaviors are more common, such as on weekend days (e.g., (7)), and EMA protocols detecting higher-risk but infrequent behavior such as simultaneous alcohol and cannabis use also rely on high participant compliance(8). Unfortunately, compliance rates for EMA protocols average around 75%(9), and young adults are less likely to complete survey prompts on weekend/heavy substance use days(7). Due to the need to balance high compliance with minimizing participant burden and disruption to their daily lives, EMA protocols may not be adequately capturing behavior when health risks of interest are more likely. Low compliance can reduce our understanding of the etiology of substance use behaviors in daily life and, by missing responses during high-risk time windows, moments of greatest risk when intervention content is most needed may be less likely to be detected.

Recent efforts have been made to increase participant engagement and thereby compliance in EMA study protocols (e.g.,(10),(11)). One promising approach is to personalize the interface, such as using their name at each prompt. Recent EMA trials have shown that personalization can have an overall and time-varying impact on participant compliance throughout the protocol(12). Another useful personalized approach targeting engagement may be to provide participants with a data dashboard (DD) to view their progress in an EMA protocol, the amount of money they have received thus far, and their progress toward a monetary bonus for high compliance. Whether such a DD can increase compliance in an EMA protocol overall and across time, as well as whether a DD has immediate impacts on participant compliance in a survey prompt, awaits empirical investigation.

As described in our team's study protocol paper(13), Project ENGAGE involved the creation of a DD that delivered real-time feedback on the participant's study progress in terms of number of surveys completed, amount of compensation earned, and progress toward a high-compliance bonus. Participants were randomly assigned to either (a) an "EMA as usual" (EMA Group) protocol in which they participated in a 21-day EMA study with 4 survey prompts per day or (b) an "EMA + DD" (EMA+DD Group) protocol in which they participated in the same study design but also

received a personalized message with a DD once per day. Using a micro-randomized trial(14) design, participants in this group were randomized each day to which survey prompt of the day would include a personalized message and embedded DD showing up-to-date information about their progress in the study protocol.

The goal of the current study was to report on the findings from the protocol reported by Lanza et al. (under review) to evaluate the effect of including a personalized DD in a text-based survey prompt on study compliance outcomes among college students participating the EMA protocol. Specifically, the present study had three aims:

1. We aimed to evaluate the overall effect of a daily DD by estimating group differences in overall compliance, average completion time (if completed), and subjective experiences of the EMA protocol between the two groups.
2. We aimed to estimate group differences in compliance across weeks in the study (overall compliance; average completion time across Weeks 1, 2, and 3) to determine whether effects varied with time in study.
3. Within the EMA+DD Group, using a micro-randomized trial, we aimed to examine the momentary impact of receiving a DD on survey completion (yes/no) and survey completion time. Further, we aimed to examine whether the time of day the DD was sent moderated the association between receiving a DD on whether a survey was completed and completion time.

Method

Participants and Procedures

College students from a public university in the Northeastern region of the United States who previously participated in a campus-wide survey in February and March 2023, agreed to be contacted about future research opportunities, and reported past-month alcohol use or lifetime cannabis use on the initial survey were provided information about the current study. Interested participants

completed an eligibility screener and, if eligible, were provided the study consent form. To be eligible, participants must have been between 18- 25 years old and have reported alcohol and cannabis use in the past 30 days. To facilitate automation of this complex design, participants also were required to use an iPhone with iOS 12 (operating system) or above to complete surveys. A total of 411 students were invited to the study. Of those invited, 200 students replied and were emailed survey screeners, of which 101 students were deemed eligible. Ninety-two students participated in the study and 1 student withdrew, yielding a final analytic sample of 91 participants. Participants primarily identified as female (67%), White (92%), and non-Hispanic (89%), not affiliated with a fraternity or sorority (75%), and residing off-campus (70%). See Table 1 for a full summary of demographic characteristics.

Table 1
*Participant Demographics (*n=*91)*

Demographic	Response options	*N (%)*
Sex		
	Male	30 (0.33)
	Female	61 (0.67)
Gender		
	Man	29 (0.32)
	Woman	59 (0.65)
	Non-Binary	2 (0.02)
	Prefer not to say	1 (0.01)
Hispanic		
	Yes	10 (0.11)
	No	81 (0.89)
Race		
	White	84 (0.92)
	Black	1 (0.01)
	Asian	2 (0.02)
	Multiracial	4 (0.04)
Greek		
	Yes	23 (0.25)
	No	68 (0.75)
College Standing		
	First year	14 (0.15)
	Second year	23 (0.25)
	Third year	25 (0.27)
	Fourth year	27 (0.30)
	Fifth year	2 (0.02)
Residence		
	Parent's or relative's home	1 (0.01)
	College dorm/residence hall	23 (0.25)
	House/apartment/room	64 (0.70)
	Fraternity/sorority house	2 (0.02)
	Prefer not to say	1 (0.01)

Study procedures were approved by the Institutional Review Board at Penn State. Once participants provided informed consent and were deemed eligible for the study, they were asked to complete an online baseline survey via REDCap that took approximately 15-20 minutes. Participants were then randomized to one of two conditions: (1) a standard EMA protocol (4 surveys/day for 21 days) with standard text messages pushed at each prompt to complete the survey (EMA Group), or (2) the same protocol as in the EMA Group, plus a personalized message and DD reflecting their current progress in the study (EMA+DD Group) at one randomly selected prompt per day. Figure 1 shows a sample DD delivered via text message.

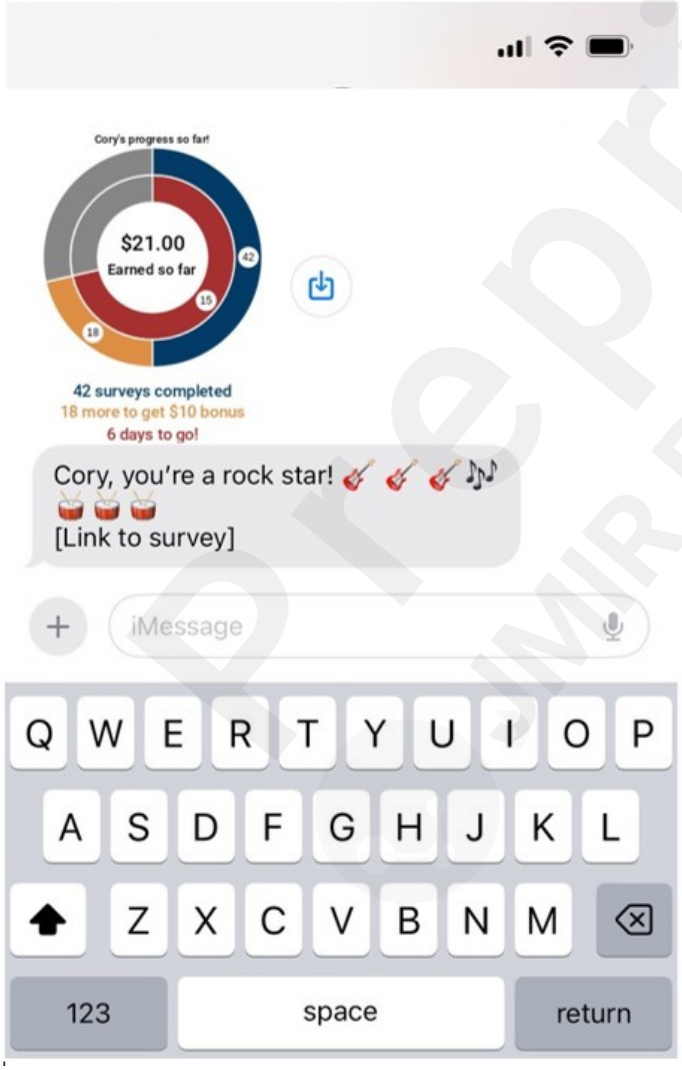


Figure 1. Screenshot of sample data dashboard from Project ENGAGE study team.

EMA survey prompts were provided via automated text messages (via REDCap) for all

participants at the same times each day: 11 AM, 2 PM, 5 PM, and 8 PM. EMA surveys took approximately 1 minute to complete, and participants were allotted 60 minutes to complete the survey, after which the personalized link would expire. Reminder texts were not provided, given our focus on short-term compliance outcomes. The DD was provided at one randomly selected text message occasion per day. To do this, REDCap worked in conjunction with a private server implemented by the research team. The server was used to monitor the generation of EMA surveys, with a script then calculating the information needed to populate the current DD. The server provided the DD at one randomly selected prompt per day to the EMA+DD Group. Participants could earn up to $67 via an e-gift card for full participation in the study. Specifically, participants were compensated $10 for the baseline survey, $0.50/daily survey, a $10 bonus if they completed 70+ out of the 84 surveys, and $5 for completing a brief exit survey. Additional details regarding the study can be found in the protocol paper (see Lanza et al., under review).

Measures

In preparation for modeling the study outcomes, we first coded two variables at each prompt. At each text message occasion, a binary indicator was coded 1 if participants completed the survey within 60 minutes of receiving a prompt, 0 otherwise. Additionally, a continuous indicator of completion time was coded as the number of minutes between receiving a prompt and completing the survey, conditional on completing the survey at that prompt.

Four primary outcome variables were examined as a function of intervention group (EMA Only vs. EMA+DD). First, overall study compliance was calculated as a person-level variable by summing the binary indicator of study completion across the 84 prompts. Second, average completion time was calculated as an individual's average completion time (i.e., time between survey prompt and submitting that survey), conditional on completing that survey (i.e., if the binary compliance indicator = 1 at that prompt). Third, self-reported protocol experiences were assessed once for each participant at the exit survey with seven quantitative variables (e.g., "How

personalized did you feel the text messages were for you?"; see Table 2 for the complete list of questions). Fourth, subjective experiences were assessed as part of the exit survey, with open-ended questions slightly modified between the two groups to assess experiences with each condition.

Table 2
Intervention Group Differences in Self-Reported Experiences with the Study Protocol, Assessed at Exit Survey (Day 21)

Subjective Experience	EMA-Only Group *M* (*SD*) or *N (%)*	EMA + DD Group *M* (*SD*) or *N (%)*	*t* or X^2	*P*
How personalized did you feel the text messages were for you? (*1 = not at all personalized to me to 7 = very personalized to me*)	3.5 (1.6)	4.3 (1.4)	2.46	.02
Overall, how easy was it to complete the surveys on your iPhone? (*1 = very difficult to 7 = very easy*)	6.4 (0.7)	6.5 (1.0)	0.15	.88
Overall, how engaged or motivated did you feel to complete the surveys? (*1 = not at all engaged to 7 = very engaged*)	5.0 (1.4)	5.0 (1.3)	-0.32	.75
Overall, how burdensome was it to complete the surveys on your iPhone? (*1 = not burdensome at all to 7 = very burdensome*)	3.3 (1.5)	2.7 (1.5)	-1.70	.09
Number of participants who said they did not get tired of completing the surveys during the study.	8.0 (18.6%)	13 (27.1%)	0.50	.48
How many days into the study did you begin to get tired of completing the surveys? (Out of those who said they did get tired)	11.1 (4.8)	11.3 (3.7)	0.15	.88
Were there certain surveys that were typically more difficult to complete on-time than others? Check all that apply: *Weekend*	18.0 (41.9%)	23.0 (47.9%)	0.14	.72
Were there certain surveys that were typically more difficult to complete on-time than others? Check all that apply: *Weekdays*	3.0 (7.0%)	5.0 (10.4%)	0.04	.84
Were there certain surveys that were typically more difficult to complete on-time than others? Check all that apply: *Any particular survey time*	29.0 (67.4%)	35.0 (72.9%)	0.12	.73
Were there certain surveys that were typically more difficult to complete on-time than others? Check all that apply: *11am*	6.0 (14.0%)	11.0 (22.9%)	0.68	.41
Were there certain surveys that were typically more difficult to complete on-time than others? Check all that apply: *2pm*	7.0 (16.3%)	6.0 (12.5%)	0.05	.83
Were there certain surveys that were typically more difficult to complete on-time than others? Check all that apply: *5pm*	10.0 (23.3%)	12.0 (25.0%)	0.00	.99

Were there certain surveys that were typically more difficult to complete on-time than others? Check all that apply: *8pm*	12.0 (27.9%)	17.0 (35.4%)	0.29	.59
Was the compensation level adequate based on the amount of time you spent completing these surveys?	33.0 (84.6%)	43.0 (97.7%)	3.06	.08

Analytic Plan

Descriptive statistics were calculated for all demographic variables. Outcome measures were then calculated as described above. For exploratory analyses we also calculated overall study compliance for each person within week and within day. To address Aim 1, Poisson regression was used to compare group differences in person-level compliance (person-level count of completed prompts as outcome variable). The group differences in other person-level quantitative variables were tested using t-tests (for continuous outcomes) and chi-square tests (for binary outcomes). Responses to open-ended questions about participants' subjective experiences were summarized by identifying common themes that emerged across responses.

Aim 2 analyses focused on study compliance and completion time, calculated within week and within day to examine possible time trends in differences across groups. To examine differences across Weeks 1 through 3 of the study, repeated measures ANOVAs were specified to model an outcome as a function of group, week in study (represented by two dummy-coded variables with Week 1 serving as the reference group), and the group-by-study week interactions. Significant interaction terms were probed to interpret specific differences across weeks. Differences in daily compliance and daily completion time were examined graphically.

To address Aim 3, we used generalized estimating equations (GEE) to specify two models using all 84 time points. For Model 1, the outcome was moment-level survey completion; for Model 2, the outcome was completion time, given that the EMA was completed within 60 minutes. Analyses included only individuals in the EMA+DD Group, and both models included the following predictors: receiving a DD at that moment (reference = none), prompt at which DD was provided

(reference = 11 AM), and the interaction between moment-level DD and prompt of the day. This analysis follows recommended procedures to analyze data from a micro-randomized trial(14). All quantitative analyses were conducted in R version 4.3.0.

Results

Aim 1: EMA vs. EMA+DD Group Comparisons

Overall, out of a possible 1,911 days of data and 7,644 survey prompts delivered (4/day for 21 days), participants completed 5,931 (77%) EMAs. Participants in the EMA+DD Group completed *M* = 64.5, *SD* = 15.7 EMAs, and individuals in the EMA Group completed *M* = 65.1, *SD* = 13.5; this difference was non-significant, $t(88.9) = 0.172$, $p = .864$. Of EMAs completed, however, participants in the EMA+DD Group completed the survey significantly faster (EMA Group: *M* = 881.2, *SD* = 323.4 seconds vs. EMA+DD Group: *M* = 738.8, *SD* = 272 seconds), *B* = -142.37, *SE* = 62.44, $p = .025$.

Group comparisons of subjective experiences are shown in Table 2. Overall, participants in the EMA+DD Group were significantly more likely to perceive the text messages as personalized than participants in the EMA Group. Participants in the EMA+DD Group were marginally more likely to perceive the compensation level to be adequate ($p = .063$) and to perceive the protocol as less burdensome ($p = .093$).

With regard to qualitative participant feedback about the use of the DD within the EMA+DD Group, participants noted that they liked seeing their progress (*n* = 14; “I loved seeing my progress and LOVED that it gave me a countdown”), that it was easy to understand or they liked the design (*n* = 13; “Showed completion in a digital metric”), that it helped them stay engaged (*n* = 3; e.g., “It showed me how much I had left to do and motivated me to keep completing the surveys”), and seeing the money they had earned so far (*n* = 3; “It showed me how much I was making”). Regarding dislikes, some participants noted that it was confusing or that the information could be clearer (*n* = 6; e.g., “took me a second to understand it”), wanting more access to it (*n* = 3; e.g., “I want constant

access to it"), disliking the information provided (*n* = 2; e.g., "I didn't like seeing how many days I still had left"), the functionality (*n* = 1; "It didn't always load properly for me"), and the visual appeal (*n* = 1; "boring colors"). Finally, participants were asked which features of the DD graph were most incentivizing. Participants positively responded to the amount earned so far (*n* = 21; e.g., "I like seeing how much I had earned so far!"), their progress in the study (*n* = 14; e.g., "knowing how many days were left"), the bonus specifically (*n* = 12; e.g., "Telling me how many more surveys I needed to complete before I earned an extra $10"), and the general design (*n* = 3; "coloured visual wheel not words").

Aim 2: Group Differences across Week in Study

For both groups, the mean number of EMAs completed is shown in Figure 2, and the mean number of seconds to complete a survey is shown in Figure 3. A repeated measures ANOVA model showed that overall, there were significant differences in the mean number of surveys completed across the three study weeks ($F = 17.33$, *adjusted* $p < .001$). The interaction between the groups and study week was not significant ($F = 2.41$, *adjusted* $p = .104$). Post-hoc analyses also did not reveal any significant differences between the two groups at any of the three weeks (Supplementary Table S1).

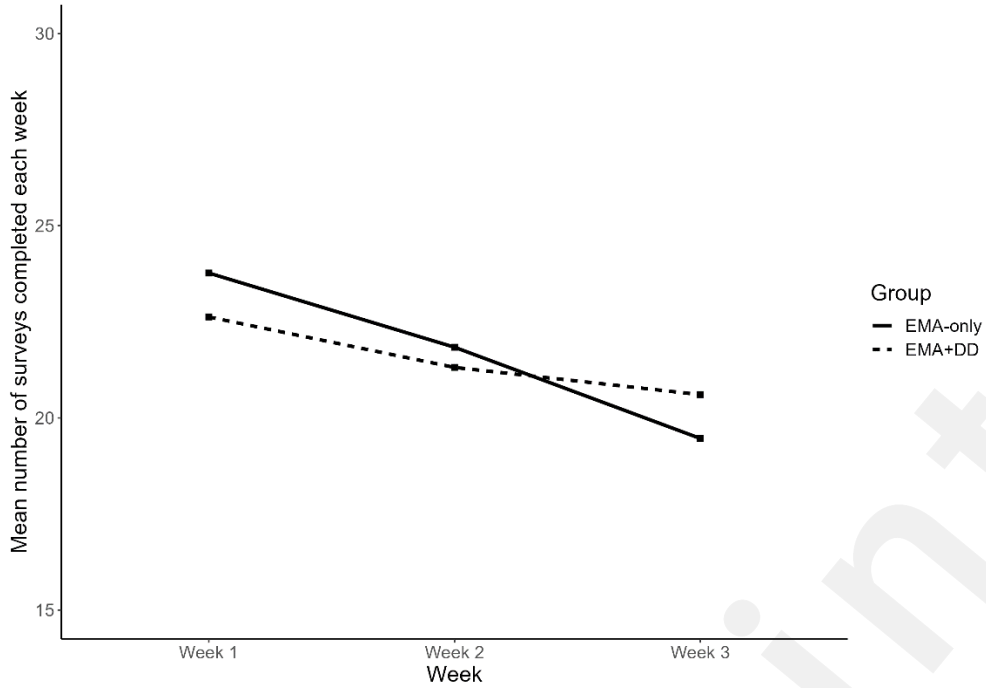
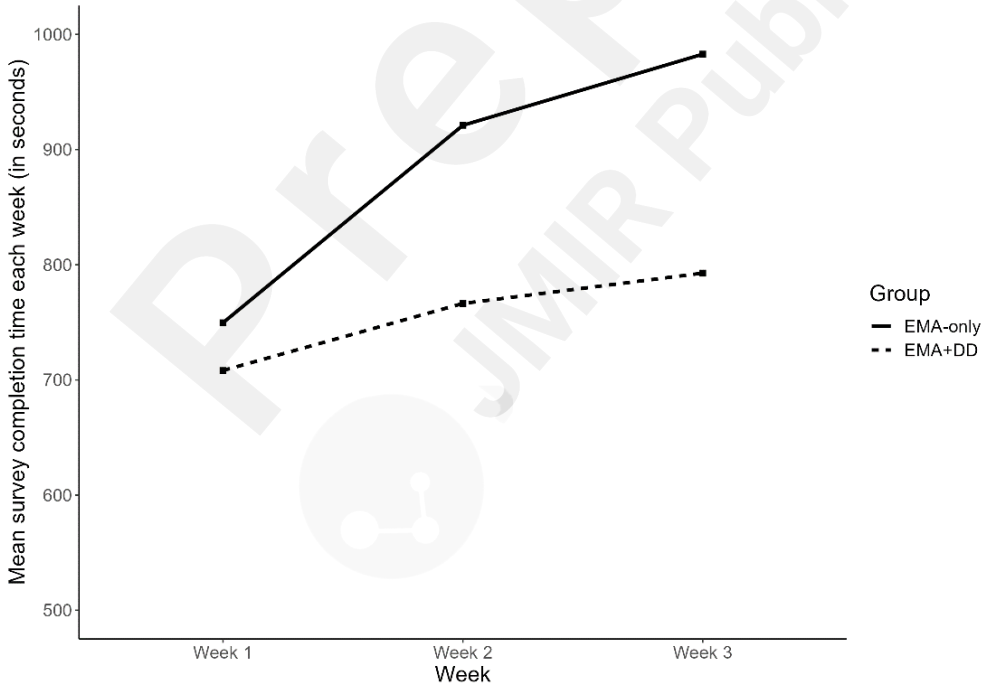


Figure 2. Mean number of surveys completed each week for the EMA+DD group (dashed line) vs. the EMA Group (solid line). Mean number completed decreased with each week, with no significant differences between groups.

Figure 3. Mean number of seconds to complete a survey for the EMA+ DD group (dashed line) vs.



the EMA Group (solid line). Survey completion in Week 1 faster compared to later weeks, with the EMA+DD group completing surveys significantly faster overall.

A separate repeated measures ANOVA showed that there were significant differences in the mean survey completion time across the three study weeks (F = 10.96, *adjusted* p < 0.001). Post-hoc comparisons showed that the differences in the survey completion times were significant for Week 1 vs. Week 2 and Week 1 vs. Week 3 but not for Week 2 vs. Week 3 (Table 4). Completion times were faster in the first than the second and third weeks. Participants in the EMA+DD Group exhibited significantly shorter mean completion times than the EMA Group (F = 3.97, p = .049). The interaction between the EMA+DD Group and study week was non-significant (F = 2.46, *adjusted* p = .099). Post-hoc analyses suggested that there were no differences between the two groups at Week 1 (t(88.14) = 0. 63, p = 0.531), but there were significant differences in completion time between them at Week 2 (t(83.48) = 2.01, p = .047) and Week 3 (t(80.85) = 2.21, p = .030).

Table 4
Momentary Differences in Completion Time (Among Completed Prompts) Across All Study Timepoints for Participants in the EMA+DD Condition, Model 2

Model 2	**Outcome: Moment-level completion time. n = 48, person moments =3,098**				
Predictors	*B*	95% CIs	*SE*	Hotelling	*P*
(Intercept)	865.10	(744.80, 985.50)	59.50	211.18	<.001
Data dashboard [ref=none]	-86.00	(-225.50, 53.60)	69.10	1.55	.22
2pm prompt [ref=11am]	-183.80	(-309.80, 57.90)	62.30	8.70	.01
5pm prompt [ref=11am]	-102.70	(-227.80, 22.40)	61.90	2.75	.10
8pm prompt [ref=11am]	-204.20	(-316.0, 92.30)	55.30	13.62	.00
Data dashboard [ref=none] x 2pm prompt [ref=11am]	83.50	(-112.40, 279.40)	96.90	0.74	.39
Data dashboard [ref=none] x 5pm prompt [ref=11am]	48.70	(-178.00, 275.40)	112.20	0.19	.67
Data dashboard [ref=none] x 8pm prompt [ref=11am]	53.00	(-129.70, 235.80)	90.40	0.34	.56

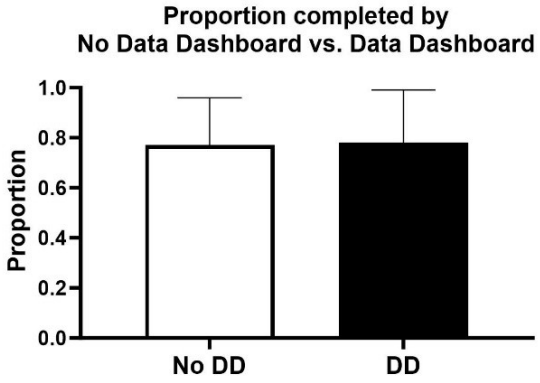
Aim 3: Momentary Impact of DD on Compliance for the EMA+DD Group

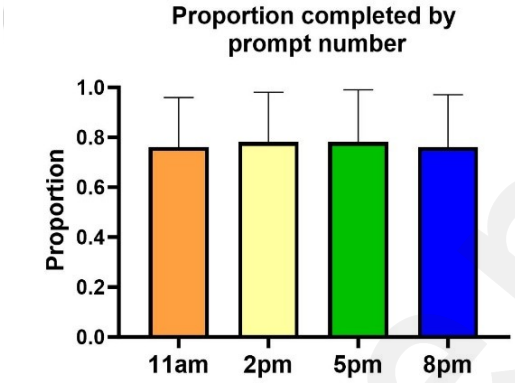
Survey completion. Across moments in the study within the EMA+DD Group, receiving a DD at a particular prompt did not significantly increase odds of EMA completion at that same prompt (OR = 1.25, 95% CL [0.94, 1.65]; Table 3; Figure 4). Odds of completing an EMA did not differ significantly by time of day (Table 3; Figure 5). For the DD by time-of-day interaction, the DD was more effective in increasing compliance only when it was sent at 11 AM compared to 5 PM (Table 3; Figure 6).

Table 3
Momentary Differences in Prompt Compliance Across All Study Timepoints for Participants in the EMA+DD Condition, Model 1

Model 1	**Outcome: Survey completion within the next hour n = 48, person moments = 4,014**		
Predictors	OR	95% CIs	*P*
(Intercept)	3.07	(2.20, 4.27)	<.001
Data dashboard [ref=none]	1.25	(0.94, 1.65)	.13
2pm prompt [ref=11am]	1.19	(0.93, 1.52)	.16
5pm prompt [ref=11am]	1.24	(0.96, 1.62)	.10
8pm prompt [ref=11am]	1.04	(0.82, 1.33)	.74
Data dashboard [ref=none] x 2pm prompt [ref=11am]	0.78	(0.54, 1.11)	.17
Data dashboard [ref=none] x 5pm prompt [ref=11am]	0.56	(0.37, 0.87)	.01
Data dashboard [ref=none] x 8pm prompt [ref=11am]	0.83	(0.54, 1.27)	.39

Figure 4. Average proportion of surveys completed by intervention group





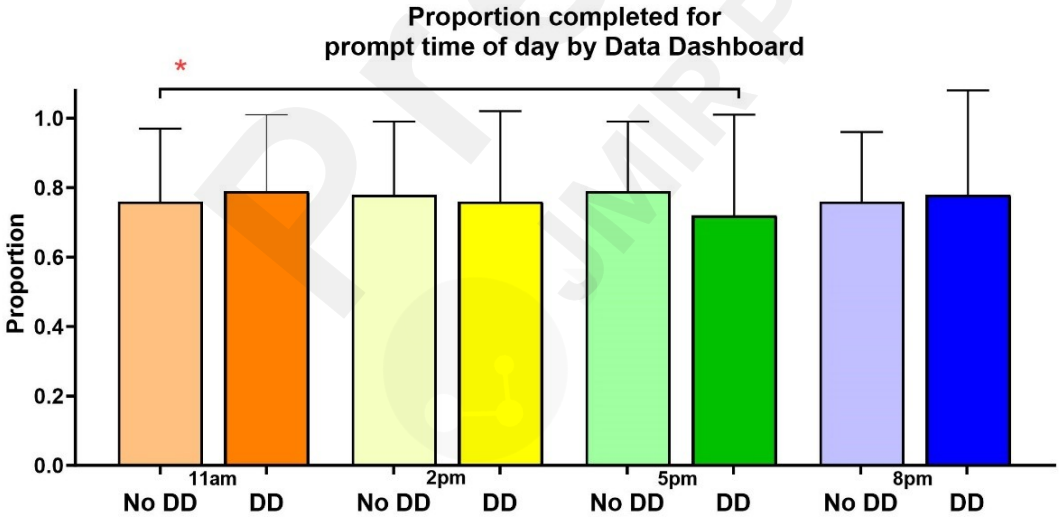


Figure 5. Average proportion of surveys completed across prompt time-of-day.

Figure 6. Proportion of surveys completed at each time of day by intervention group. (DD= data dashboard)

Survey completion time. Across occasions in the study for the EMA+DD Group, providing a DD versus providing no DD did not significantly affect survey completion time (*B* = -86.00, 95% CL [-225.50, 53.60] *p* = .22; Table 4 and Figure 7). There were, however, significant momentary differences in completion time based on the time the prompt was delivered. Compared with 11 AM prompts, participants completed EMAs in significantly less time at 2 PM (*B* = -183.80, 95% CL [-309.80, 58.90], *p* = .01; Table 4 and Figure 5),8 PM (*B* = -204.20, 95% CL [-316.0, 92.30], *p* <0.01; Table 4 and Figure 8), and there was a trend-level difference compared to 5 PM (*B* = -102.70, 95% CL [-227.80, 22.40], *p* = 0.10; Table 4 and Figure 5). The DD-by-occasion time interaction was not statistically significant (Table 4).

Figure 7. Average survey completion time (and standard deviation) across intervention groups. (DD= data dashboard)

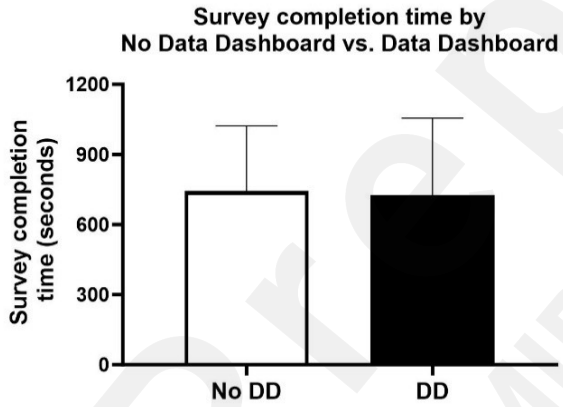
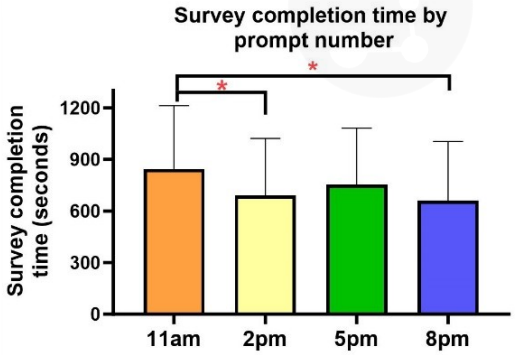


Figure 8. Average survey completion time (and standard deviation) across prompt time-of-day.



Discussion

The overall goal of the current pilot study was to examine the impact of providing a real-time DD displaying participants' progress in an EMA study on multiple indicators of compliance and subjective experiences with the EMA protocol. Our pilot had two randomly assigned groups of college students who recently engaged in alcohol and cannabis use: the EMA Group completed a 21-day EMA protocol on health behaviors, and the EMA+DD Group completed the same 21-day protocol but also received personalized messaging and a DD at one of four prompts each day. Overall, between-group findings and week-level analyses indicated that while the groups did not differ on number of EMAs completed, participants who received a DD overall completed the survey faster than participants who did not. Importantly, although compliance rates overall declined across the three weeks, in the last two weeks participants in the EMA+DD Group responded significantly faster than the EMA Group. This is a key finding, as it is common for participants to habituate to interventions during the course of a study, resulting in diminishing effects over time (e.g., (15)). Further, given general compliance concerns(9) and the tendency for study compliance to wane over time in EMA protocols(16), providing a personalized message and DD appears to be an effective way to increase completion times, particularly in later weeks of a study. Our results parallel other micro-randomized studies in that intervention effects often depend on the length of time in the study. For example, Carpenter et al.(12) found that different messages to enhance self-monitoring of alcohol use varied in their effectiveness early vs. later in the study.

Differences were also observed with regard to subjective experiences, such that participants who received a DD were more likely to perceive the text messages as personalized, and marginally more likely to perceive the compensation level as adequate and to feel less burdened during the study. Qualitative findings were generally in line with these results, with participants indicating that seeing their progress helped them stay more engaged. Further, participants seemed to be particularly motivated to secure the bonus. The most commonly reported areas of needed improvement were a clearer explanation of the wheel and wanting full access to the DD at all times. Future work may

build from these findings by providing an online digital module that provides an overview of the DD to participants. The finding that participants wanted access to the DD throughout the study is encouraging, as it suggests that participants did not feel burdened by frequently viewing their DD. This finding is in alignment with users' preferences for personalization pertaining to ongoing monitoring and feedback during mobile health interventions(17).

Interestingly, within the EMA+DD Group, providing a DD did not significantly impact participants' likelihood of completing the survey or completion time at the moment-level. There was, however, a significant moderation effect based on the time of day the DD was sent. Specifically, the impact of a DD on likelihood of completing the survey was greater at the first prompt of the day (11AM) than at the 5 PM prompt. Perhaps the momentary effects of a DD are subtle and depend time-varying moderators (e.g., time of day, time in the study) to increase momentary effectiveness. Our overall findings do suggest that providing a DD promotes overall greater EMA engagement. Future research may benefit from exploring whether having access to the dashboard throughout the study period vs. receiving the DD at particular times each day is more impactful on compliance.

Several limitations should be noted. First, participants were college students who were primarily White from a large, public university in the Northeastern region of the US. Findings may be less generalizable to young adults who do not attend college or college students who are from underrepresented backgrounds. Second, relatedly, participants were recruited from a larger study based on their recent alcohol and cannabis use, and were thus a convenience sample and not necessarily representative of college students at the university. Lastly, given that the current study was a small pilot study, we were underpowered to detect significance for some small effects, including the effect of person-level factors and a more thorough investigation into time-varying moderation effects. This was compounded by a large number of exploratory hypotheses considered in this pilot study. Future work should build from these findings with a larger, more diverse sample of young adults to replicate and clarify the utility of DDs more broadly.

Overall, the current study found that providing participants with a DD resulted in faster completion times, particularly in later weeks of the EMA protocol. Findings may have implications for future EMA studies and for both micro-randomized trials and just-in-time interventions that rely heavily on participant compliance with self-report surveys. Specifically, given that participants overall liked having access to the DD and exhibited faster completion rates, providing participants with a DD may be highly useful for engagement, particularly for researchers aiming to assess behavior that occurs close in time to when the survey prompt is provided. Faster completion times would be particularly critical when survey responses are used to trigger the just-in-time delivery of intervention content. Although future research is needed to determine whether constant access to a DD or time-specific access is more effective, our study suggests that providing a DD earlier in the day and/or at the first prompt of the day is more beneficial than later in the day. Such an approach may be particularly useful for daily diary studies that inquire about yesterday's behavior early in the day.

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Abbreviations

DD: Data dashboard

EMA: Ecological momentary assessment

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Ethical approval: The Institutional Review Board at The Pennsylvania State University approved this study.

Supplementary Materials

This information supplements “Impact of Providing a Personalized Data Dashboard on Ecological Momentary Assessment Compliance among College Students Who Use Substances: A Pilot Micro-randomized Trial”

Table S1

Group Differences in Study Compliance and Survey Completion Time Assessed at Week Level

Outcome		EMA-Only Group *M*	EMA + DD Group *M*	*t*	*df*	*p*-value
Compliance	Week 1	23.77	22.63	1.213	88.86	0.228
	Week 2	21.84	21.31	0.470	88.99	0.639
	Week 3	19.47	20.6	-0.774	88.69	0.441
Speed of Survey Completion	Week 1	749.58	708.13	0.628	88.14	0.531
	Week 2	921.01	766.32	2.013	83.48	0.047
	Week 3	982.76	792.68	2.206	80.85	0.030

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