

activities. A different color represents each activity. Days on the calendar are by default colored with the most frequent activity for that day. Color intensity represents the balance of activities -- higher intensity shows higher imbalance.

There is an option to integrate a wearable device to automatically monitor sleep. This reduces the workload required to track sleep times and provides more accurate monitoring.

The design also includes a social component to help users maintain their social relationships. This was achieved through analyzing users' friends' schedules and locations to remind users to send empathetic messages and appropriate reminders.

Lastly, the design features a dashboard component that scores a user's life balance. This uses a bar chart to visualize a user's effectiveness in balancing their work, social and sleep activities. The dotted black line shows a user's pre-selected goals for each category. The app provides suggestions on how to improve life balance based on the score that is generated.

#### *User Testing Feedback*

We conducted user testing on our prototype with 9 participants and summarized their feedback as follows:

- Most participants found the social feature to be interesting and believed it helps build connections with their friends by showing compassion and empathy.
- Too many features caused redundancy and disconnect, especially between the scheduling and social features.
- The scheduling feature had no outstanding distinctions from general scheduling apps, which lead to the doubt of its necessity.

- The dashboard was difficult to understand. It was hard to identify the level of life balance by looking at the bar chart.
- It will be too stressful to have to constantly update schedules.
- The idea of "life balance" is subjective and varies by individuals.
- Privacy concerns regarding the disclosure of information. Some participants did not want their friends to know how unbalanced their lives are.

We decided to shift our focus to the social relationships. User testing feedback reveals that our calendar feature was too similar to existing scheduling apps. The dashboard was also cluttered and confusing to understand; accuracy of information depicted here would rely on constant updates from our users, which is stress inducing.

#### *Modified User Enactment Method*

We employed Modified User Enactments (MUE) to further examine social relationships. We used Odom et al.'s User Enactment methods [3] as a point of reference. Our study was "modified" in the sense that the physical form and the social context were not constructed by us. We recruited 4 Cornell MPS Information Science students during the week before final examinations. All participants expressed high levels of stress due to quickly approaching deadlines. Our MUEs took place in an on-campus study lab, where most of our participants naturally complete coursework. The social context did not need restructuring -- our participants were already in a stressed-out state of mind. Because the physical form of a study space was immediately available to us, there was no need for us to recreate this. Relying on a real-world scenario allowed us to observe more natural interactions between participants and the environment.

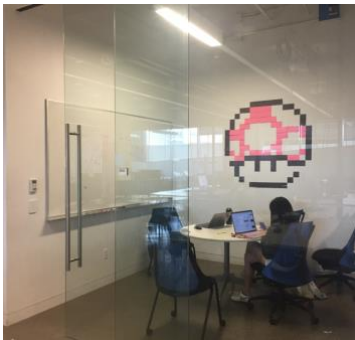


Figure 3: This image shows the physical location of our Modified User Enactments.

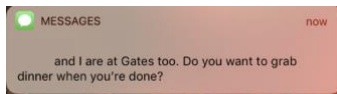


Figure 3: Notification sent during MUEs. This shows a message from a friend inviting our participant to grab dinner.



Figure 4: Conversation log from MUEs. This shows the participant responding to prompts to send messages to friends.

The goal for our MUEs was to better understand emotional reactions to receiving encouraging messages during moments of high stress, and gauge willingness to send encouraging messages. Parts of Odom's User Enactment methods retained in our MUE were the use of a lo-fi prototype and a loose script that our participants had to follow.

A mobile phone was provided with the names of our participants' closest friends programmed into the phone's contact list -- this is our low-fidelity prototype. MUE sessions took place with one participant at a time. Each participant was instructed to sit at a table and continue working on their assignments for 30 minutes with the mobile device placed beside them. Researchers sat in a separate room to orchestrate a series of texts to be sent to our participants. Texts were programmed to appear as if they were being sent from a participant's close friend. These texts are meant to represent two types of push notifications to be sent from our mobile app design:

1. Fun and positive messages from close friends
2. Prompts to send similar messages to close friends

Each participant was observed and interviewed at the end of their MUE session to understand their thoughts and feelings while receiving each notification.

#### *Modified User Enactment Findings*

All participants expressed positive emotions when receiving friendly text messages from close friends. Figure 3 displays a message from a close friend inviting the participant to dinner. Feelings of annoyance and obligation were absent. One participant claimed "I don't feel obligated to go to lunch if I'm busy. I won't feel bad if I tell her, if she's a close friend, 'no'". Receiving invitations from friends provided something for our participants to look forward to. For those who weren't able to leave their work, it was a nice reminder that

their friends were thinking of them. This changed the attitude with which participants proceeded with their work.

All participants were uncomfortable responding to prompts for sending reminders to close friends. Although one participant ultimately replied "yes" to this prompt, he did not feel comfortable doing so and thought the interaction was "forced".

However, participants were more receptive towards prompts to invite friends to engage in fun activities. Half of our participants appreciated having activity suggestions automatically generated because they provided opportunities to spend time with friends.

#### **Final Design**

View InVision Prototype:

[https://projects.invisionapp.com/share/M4I4AI5TJN3#/295508388\\_02\\_Home\\_02](https://projects.invisionapp.com/share/M4I4AI5TJN3#/295508388_02_Home_02)

Our final design solution is a mobile app that fosters social relationships by sending/receiving positive messages to/from friends.

Our app utilizes an integrated analysis of users' data to curate appropriate notifications. It is composed of four tabs: Home, Friends, Calendar, and Settings.

The Home tab lists notifications that are generated through an analysis of a user's personal interests, locations and schedules. This incorporates feedback from user interviews that highlight the subjectivity of mental well-being. Allowing users to specify personal interests provides user experiences that are tailored to unique needs of each individual. The app also incorporates external information such as time of day and weather to make appropriate suggestions for activities.

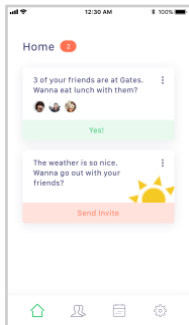


Figure 5: Final design home tab.

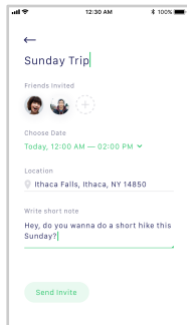


Figure 6: Final design event invitation screen.

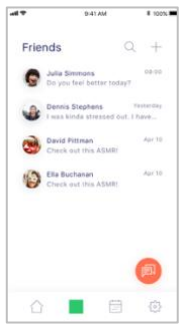


Figure 6: Final design Friend's tab.

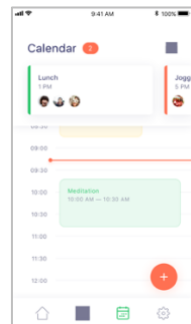


Figure 7: Final design calendar tab.

Insights generated from our user interviews and modified user enactments identified three scenarios that users are willing to engage with:

1. Inviting friends to participate in social activities
2. Participating in social activities suggested by the app (e.g. taking a walk when the weather is nice.)
3. Reminding users to rest

The app utilizes GPS locations to send notifications. When a user is within close proximity to friends, the app will send notifications with suggestions for social activities based on attributes such as time of day. For example, if it's around noon, users may see a notification like this: "3 of your friends are at (+location). Wanna eat lunch with them?" This feature supports the concept of a joint activity that surfaced in our literature review. Joint activities create relatedness, and relatedness is beneficial for well-being [2].

The app also gathers weather data and user preferences to create appropriate notifications that fit various contexts. For instance, the app can send notifications to remind users to go for a short walk with friends if the weather is nice. Additionally, the app can prompt users to invite friends to go shopping if that is a common interest specified within their settings.

The action buttons of notifications were designed to portray excitement and provoke active responses. This capability supports the research conducted by Feeney et al. [1] indicating that sending supportive messages can promote well-being. However, our MUEs received mixed responses towards these types of notifications. Some users were receptive, while others found them annoying. Users can choose to hide these notifications.

The Friends tab allows users to easily import friends from social media and contact lists. Allowing easy import of contacts can increase possibilities of

interaction between people. Walrath et al. confirms that social interactions have a positive correlation to well-being [5].

The Calendar tab displays upcoming events created in the app and personal schedules. Schedule data can be imported from third-party apps such as Google Calendar. Because our users found the idea of having to constantly update schedules to be stress inducing, we reduced the emphasis placed on the calendar feature in our final design. Allowing the ability to import calendars from existing apps minimizes maintenance efforts. We removed the color coding scheme existent in our low fidelity prototype to reduce clutter. Keeping parts of the calendar feature was necessary -- a major component of our app is to send social event suggestions that are convenient to each user. This allows the app to only recommend invitations for users with available schedules.

Users can send invitations directly through the app. Our design automatically displays contacts that are available during a chosen time period. Optimizing the process of finding common availability amongst multiple people brings more opportunities for individuals to interact with friends.

The Settings tab allows users to specify permissions (addressing privacy concerns surfacing in our user tests), personal interests and updating profile and password.

## Discussion

Our research started with user interviews to better understand young adults' relationships with mental well-being. The initial findings were that mental well-being is accomplished through a balance of work, social relationships and sleep. This was followed by a co-design method where we collaboratively designed a solution with a team of experts. Based on our co-design sessions, a low fidelity prototype was produced and

user tested. Revelations from user tests led us to shift our focus on using social relationships to promote mental well-being. We proceeded with modified user enactments to further understand emotional reactions to sending and receiving positive messages. Existing literature also strongly supports the notion that social interactions are highly beneficial for mental well-being.

We see potential in our design -- our participants have expressed feeling strong positive emotions when receiving encouraging messages from their close friends in stressful moments.

There are however limitations in our research. Some participants expressed discomfort while receiving notifications to send certain messages to others. This can impact participation within our app. Further research is necessary to better understand how these notifications can be better presented.

A few participants also stated that they tend to turn off their phones or notifications in real life situations where their full attention is required. This was not accounted for in our MUEs. This limit the effectiveness of our app for this group, but does not discount our findings from our MUEs.

There were also some gaps in our co-design method. While we followed the co-design methods discussed by Sanders et al. to the best of our abilities. Our participants defaulted to the creation of a mobile app because this is what they are used to. In retrospect, our team could have provided more encouragement to explore a wider array of options. This would have further validated a mobile app as being the best solution to our problem.

While our final design is grounded in research, additional research is necessary to measure the effectiveness of our final design. This can be

accomplished through an additional round of user tests and interviews.

## Conclusion

Social relationships have major contributions to mental well-being. Small interactions between close friends yield noticeable boosts in positive emotions. Positivity can help individuals when facing stress in their daily lives.

In examining the relationship between mental well-being and young adults, we found that mental well-being is associated with a positive attitude and living balanced lifestyle.

We hope that our research will contribute to the HCI community by providing an adequate foundation for future work relating to mental well-being.

## References

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