The Relationship Between Persuasive System Design, Personality, and Engagement Within Digital Mental Health Interventions

Lisa Flemming (s2642794)

Department of Psychology, University of Twente

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1st supervisor: MSc. Lea Hohendorf

2nd supervisor: Dr. Saskia Kelders

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Abstract

Objective: Digital mental health interventions (DMHIs) can improve mental health, but low completion rates are a concern. Engagement, influenced by persuasive system design (PSD) features, may impact this. This study examines whether PSD features increase engagement in university students and if personality traits influence engagement.

Methods: Participants completed a DMHI while wearing eye-tracking glasses. Personality traits were assessed using the Mini-IPIP, and engagement was measured with the TWente Engagement with Ehealth Technologies Scale. Two groups were created: Group A completed the non-PSD module first, followed by the PSD module, and Group B did the reverse. Eye-tracking and think-aloud sessions provided qualitative data, analysed thematically. Quantitative data were analysed with t-tests and Spearman's Rank Correlation.

Results: Group B reported higher engagement (M = 2.89, SD = 0.15) compared to Group A (M = 2.32, SD = 0.44), $t(3.98) = -3.03$, $p < 0.05$. Group B also showed higher engagement after the non-PSD module (M = 3.11, SD = 0.22), $t(2) = -6.91$, $p < 0.05$. Participants preferred the PSD module, mostly due to the features Tailoring and Self-monitoring that enhanced cognitive engagement. Personality traits had unclear effects on engagement, though neuroticism negatively influenced it.

Conclusion: PSD features enhance engagement, as shown by higher engagement scores in Group B. The relationship between personality traits and engagement remains unclear. Future research should explore optimal PSD implementation and investigate the connection between personality and engagement with a more diverse sample.

Keywords: PSD, engagement, DMHI, personality traits, relationship

Introduction

In today's technological age, Digital Mental Health Interventions (DMHIs) gained an increasing importance when it comes to helping people change their behaviour and improve mental health (Kelders et al., 2020). DMHIs are increasingly more recognized as effective and therefore, can support the treatment of several mental health issues, e.g., depression, anxiety, and general distress (Gan et al., 2022; Perski et al., 2017). According to Gan et al. (2022), digital interventions are seen as an alternative alternative for those, who are unwilling and/or unable to access traditional mental health services out of geographical reasons. Despite the proven effectiveness of DMHIs, there is only a small number of individuals that complete their assigned intervention (Perski et al., 2017; Gan et al., 2022). Hence, DHMIs have various opportunities, however understanding the factors influencing their success or failure is crucial.

One of the frequently mentioned concepts for the effectiveness of a DMHI is engagement. Nevertheless, little is known about the full concept of engagement and how it is properly defined (Kelders et al., 2020). Having clearer insights into engagement would not only generate better guidelines for how DMHIs should be designed, but it can also improve the future use of online interventions (Kelders and Van Zyl, et al., 2020). Currently, three dimensions have been recognized as being involved in engagement: cognitive, affective, and behavioural (Kelders et al., 2020). The cognitive dimension requires participants to find the technology useful and engaging, with attention playing a key role in goal achievement (Kelders et al., 2020; Perski et al., 2017). Innovative tools like eye-tracking devices gained an increasing use in effectively measuring attention. The affective component is based on the emotions felt while using the technology and the feeling towards achievement (Kelders et al., 2020). The third dimension – the behavioural one – is linked to the routine that might exist to use the technology. Further, it includes the effort required to use the technology. Its usage can differ depending on the needs of the current moment (Kelders et al., 2020). The

aforementioned aspects are used as a guideline for engagement throughout this thesis. Referring back to DMHIs, engagement is often considered as an influencing factor (Graham et al., 2021) for the successful completion of interventions (Perski et al., 2017; Gan et al., 2022). Thus, as it is known that engagement might be based on the design of the DMHI to some extent (Kelders and Van Zyl, et al., 2020), there is an increasing interest in examining the efficacy of different strategies to enhance engagement (Gan et al., 2022).

Moreover, Persuasive System Design (PSD) is a way to design a system to alter behaviour through design features that persuade one to engage in target behaviour. PSD features within an intervention are defined as "computerized software or information systems that are there to reinforce, change or shape attitudes or behaviours or both without using coercion or deception" (Oinas-Kukkonen & Harjumaa, 2009). They function as a framework to guide the design of online services aimed at changing users' attitudes or behaviours (Gan et al., 2022)**.** There are different PSD feature categories, namely, Dialogue Support, System Credibility, Social Support, and Primary Task Support (Oinas-Kukkonen & Harjumaa, 2009). There are some studies on PSD and its influence on engagement. Stibe and Oinas-Kukkonen (2014) mention that users' perception of how persuasive a system is, can greatly influence their level of engagement and their willingness to use the system in the future. Kelders and Van Zyl, et al. (2020) explain that personalizing an intervention might be a very effective system strategy for the achievement of a target behaviour. However, Gan et al. (2022) argue that to understand the entire positive relationship between PSD and engagement, further research is needed. This is also stressed by Kelders et al. (2020), as they agree that a better understanding of its connection would help to design interventions that bring individuals further to their goals.

To design effective and engaging interventions one must understand which design features work best for whom. Previous literature says that there is a relationship between

personality traits and the favourability of certain PSD features (Alqahtani, 2023). The study of Alqahtani (2023) states that design features, i.e., normative influence, and social facilitation are favoured by all existing personality traits. Some personality traits, e.g., extraversion and agreeableness, are most responsive to the design feature of self-monitoring, which is part of the primary task support category. Others, with the personality trait of conscientiousness prefer the design feature of trustworthiness. Still, the relationship between personality traits and PSD remains understudied. Characteristics of the users should be considered when designing a DMHI, therefore, understanding people's personal differences regarding persuasive features can play an essential role in improving the effectiveness of persuasive apps and user adherence.

As aforementioned and given the general lack of understanding of PSD, engagement, and personality in DMHI, the purpose of this study is to investigate these relationships in further detail. Therefore, this thesis includes the following research questions:

1. Does the inclusion of PSD features engage university students more in a Digital Mental Health Intervention?
2. Is there a relationship between personality traits, PSD features, and engagement in DMHIs among university students?

It is hypothesised that the inclusion of PSD features engages students better with a DMHI. Further, it is also hypothesised that there is a relationship between personality traits, PSD features, and engagement in university students. This study employs a mixed methods design to investigate these questions. The quantitative part is gathered through questionnaires and eye-tracking, whereas the qualitative part applies a think-aloud session and an interview.

Methodology

Design

A mixed-methods design was chosen, to collect deeper insight into the experiences with PSD features, personality, and engagement in a DMHI. The eye-tracking method was chosen to find patterns or trends in attention, interest, affect, and behaviour, trying to represent engagement and finding out more about its concept and relations to PSD. In addition, the think-aloud session and the interview are used to explain, whether PSD features engage students with the online module and why it makes them more engaged. Furthermore, it was used to analyse how personality influences this relationship. Therefore, the qualitative part complements the quantitative part in this study to gain deeper insights. The design includes two groups. Half of the participants conducted the non-PSD module first and the PSD module afterward. They are called Group A. Respectively, three participants conducted the PSD module first and afterward the non-PSD module, referred to as Group B within this paper. The study gained ethical approval from the ethics committee of the University of Twente, the Faculty of Behavioural, Management, and Social Sciences (BMS). The request number is 241085.

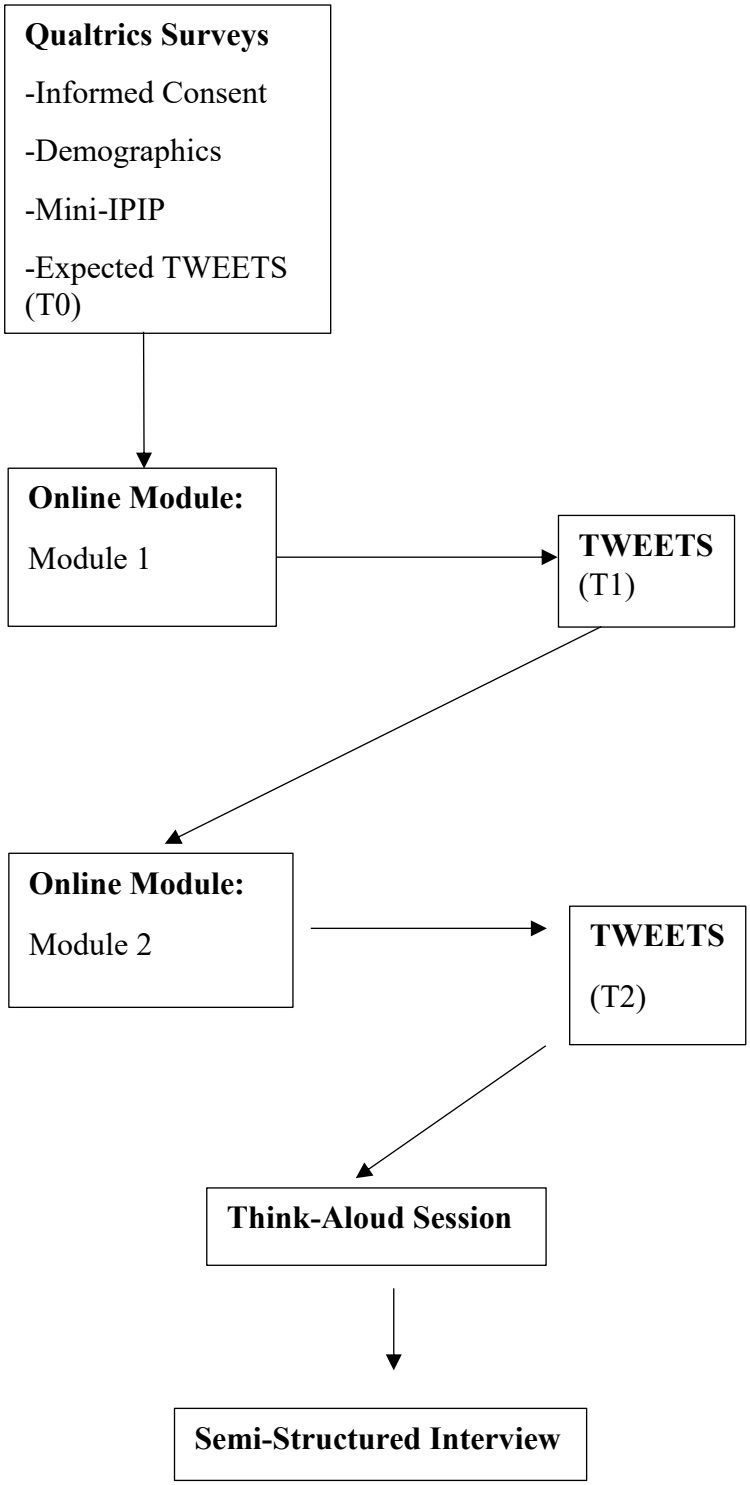
Procedure

The study consisted of four different parts, due to the mixed-methods design: The questionnaires within Qualtrics, the eye-tracking part with the online modules, the think-aloud session, and the interview. A better overview of the procedure with the specific steps can be found in Figure 1. At the beginning, participants were asked for their consent. The contact details of the researchers were provided for questions or remarks participants may have. Participants had to state their demographics and fill in the Mini-International Personality Item Pool (Mini-IPIP), and the TWente Engagement with Ehealth Technologies Scale (TWEETS), regarding their expected engagement with the modules. After that, participants were provided with eye-tracking glasses, and a short calibration took place. Then, the first online module was opened and the participants started it. Here, based on which group participants were

assigned to, they either conducted the non-PSD (Group A), or the PSD module (Group B) first. After the first module, they completed the TWEETS, regarding their past engagement. Then the participants did the second online module and filled in the TWEETS again. The recording was stopped, and the next part of the study began: the think-aloud session. The participant and the researcher rewatched the eye-tracking recording on the Tobii Pro Lab software while the session was recorded on Microsoft Teams. Simultaneously, the participant was asked to share the thoughts and feelings they had during the online module. After that, the semi-structured interview took place. In the end, the participant was thanked for their time and participation. The study took participants between 54 minutes and 1 hour, and 41 minutes to complete.

Figure 1

Overview of the Procedure



Note. Session 1 was the non-PSD module for Group A, and the PSD module for Group B; Session 2 was the PSD module for Group A, and the non-PSD module for Group B.

Participants

In total, 13 participants have conducted the study. One participant was excluded from the dataset, due to giving solely positive answers. The participants were divided between the two researchers, and thus, six participants were considered for each thesis. In general, the sample included university students (Bachelor's and Master's). Further, a necessary criterion to be selected for the study was a basic level of written and spoken English. Students were not allowed to participate in the study if they had eye conditions like presbyopia, as this could have affected the interaction with the online system. The sampling strategy used was convenience sampling. Participants were recruited over the credit system of the University of Twente (Sona Systems) and social media.

Besides, the average age of participants was $M = 21.5$, ($SD = 1.38$), with a minimum age of 19 and a maximum age of 23. Half of the participants were Bachelor students, and the other half included Master students. Likewise, an equal number of female and male participants were recruited, and they identified as either women or men.

Materials

The materials used in this study were two questionnaires, namely the Mini International Personality Item Pool (Mini-IPIP), and the TWente Engagement with Ehealth Technologies Scale (TWEETS). Another material that was used is the online intervention made with the Computerized Intervention Authoring System (www.cias.app), which participants had to go through while wearing eye-tracking glasses, provided by the University of Twente. This was collected with the software program "Tobii Pro Lab", version 24.21. For the think-aloud session, the materials that were used was Microsoft Teams. For the last part – the interview – the researcher used a semi-structured interview form (see Appendix A), which was recorded on Microsoft Teams as well. In the following, the materials will be explained in detail.

Mini International Personality Item Pool (Mini-IPIP)

The personality questionnaire used is the Mini International Personality Item Pool (Mini-IPIP) (Donnellan et al., 2006) (see Appendix B), which assesses personality traits based on the Big Five (Goldberg, 1999). It is a shortened form of the International Personality Item Pool, which originally included 50 items. The Mini-IPIP includes 20 items with four items per trait. The traits are extraversion, agreeableness, conscientiousness, neuroticism, and imagination/openness. Participants had to score themselves on a 5-Point-Likert scale from 1= "Strongly Disagree", 2 = "Disagree", 3 = "Neutral", 4 = "Agree" to 5 = "Strongly Agree". The items include statements like "I get chores done right away", which would reflect conscientiousness. Another example item that represents the absence of extraversion, so, introversion, is "I don't talk a lot". For the scoring, a higher score for a personality trait indicates that the trait exists stronger in a participant. Some items are reversed, meaning they are stated in the absence of the traits, and one has to subtract the score. Donnellan et al. (2006) state that the Mini-IPIP has great internal consistency, good criterion validity, and strong construct validity, with a Cronbach's alpha of $\alpha = 0.65$ and above.

TWente Engagement with Ehealth Technologies Scale (TWEETS)

The second questionnaire used is the Twente Engagement with Ehealth Technologies Scale (TWEETS) (see Appendix C). The goal of the questionnaire is to assess engagement at different time points, e.g., expected engagement, current engagement, and past engagement. In this paper, the researcher looked for expected engagement and past engagement. Subsequently, the TWEETS was used before participants did the online module (T0) and after each session of the online module (T1, T2). The scale of past engagement consisted of nine items, three items for each dimension; behaviour, cognition, and affect. The scale for expected engagement has equal items, the only difference is that the wording was changed. For example, when the past engagement item stated, "I enjoy using the online module", the

expected engagement item is “I will enjoy using the online module”, which would measure affective engagement. An item that measures past behavioural engagement is for example “This online module is easy to use”. The scoring is based on a 5-Point-Likert scale that has the options 0 = “Strongly Disagree”, 1 = “Disagree”, 2 = “Neutral”, 3 = “Agree”, and 4 = “Strongly Agree”. The TWEETS has high internal consistency, and sufficient reliability, such as sufficient to good validity. The Cronbach’s Alpha is $\alpha = 0.86$ and above (Kelders et al., 2020).

Online Module

The online intervention participants conducted was about relaxation techniques and consisted of two modules, one with PSD features (the PSD module) and one without PSD features (the non PSD module). Overall, there were two versions of the intervention. Participants that were assigned to Group A did the non-PSD module first, and secondly, the PSD module. It was the other way round for Group B, they had to do the PSD module first and afterward the non-PSD module. The researcher randomly assigned the groups to each participant. In the PSD module, there were eight features included, namely, Similarity, Praise, Verifiability, Rehearsal, Expertise, Normative Influence, Social Facilitation, and Tailoring. An overview of the PSD features and their implementation can be observed in Table 1. Two examples of PSD features can be found in Figure 2, demonstrating the features Social facilitation and Expertise.

Table 1

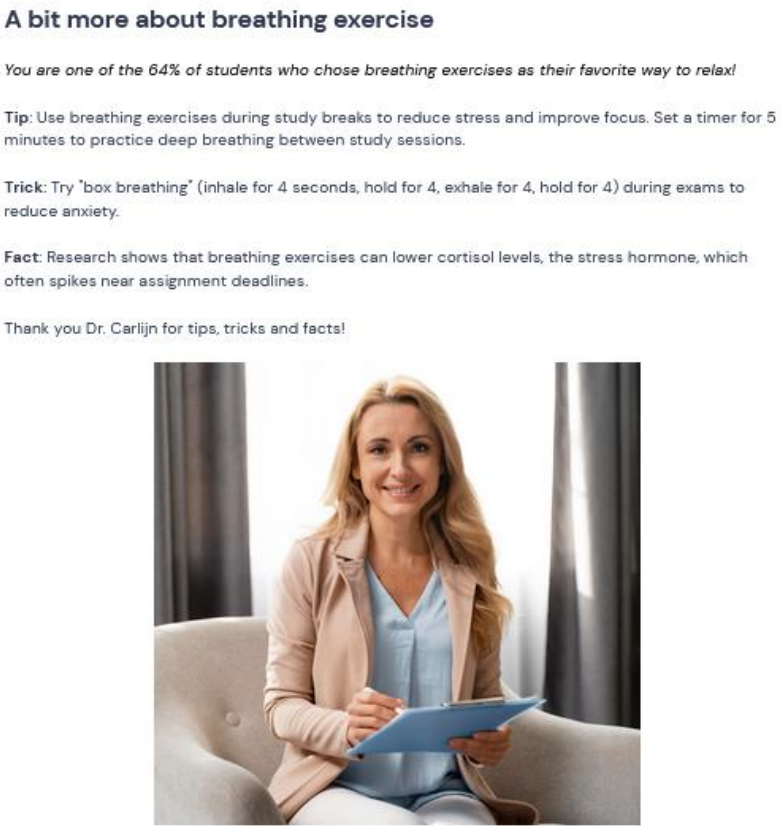
PSD Features and Their Implementation

PSD Feature	Implementation
Social Facilitation	The text says "You are one of 247 students who have completed the first session on Relaxation!/ the entire Relaxation module!"
Verifiability	The NICE guidelines link included
Praise	User was praised for their actions, e.g., Good Job!
Rehearsal	The exercises participants can do in the module, e.g., relaxation response
Normative Influence	Animated character Louise
Similarity	The use of emojis
Expertise	The inclusion of the expert in text and a picture of her
Tailoring	Information was tailored to students' life; Participant had the option to choose their preferred exercise and receive tailored information on that exercise

Note. Eight PSD features were used in the intervention

Figure 2

Example of the Features Social Facilitation and Expertise



Note. The feature Social Facilitation is shown with the statement “You are one of the 64% of students who choose breathing exercises as their favorite way to relax!”. The feature Expertise is used with the implementation of the picture of the expert based on the assumption that the intervention displays competence due to including experts.

Eye-tracking Device

A further material was the Tobii Pro Lab eye-tracking devices, provided by the University of Twente. It consisted of eye-tracking glasses, and further equipment for charging. The glasses were used for the intervention that participants went through and, their

eye movements were recorded. Heatmaps were build out of the fixation points of the eye-tracking.

Think-Aloud Session

For the think-aloud session, participants were encouraged to share their thoughts and feelings about the intervention. If participants remained silent, some probing questions were asked like “Can you explain what you were thinking at this moment?” or “How was your reaction to that page?”.

Interview

The semi-structured interview included questions that asked participants about their experience with the online module, i.e., how engaged they were with each module, and design features that made them interested and engaged in the online module, such as questions about participants’ personality. Example questions are “Which session would you go back to if you could?”, or “Were there any features or interactions that motivated you?”. As the interview was semi-structured, some flexibility was allowed to ask in-depth questions and probe further. Probing questions were for example “Why stood that out to you the most?”. For the whole semi-structured interview see Appendix A.

Data Analysis

To answer the first research question – whether including PSD features leads to higher engagement scores – several methods were applied. Namely, the eye-tracking analysis and the think-aloud session combined, and the interview analysis, both for the qualitative analysis. The quantitative analysis was analysed with the statistical software RStudio, version 4.1.1. Two different kinds of t-tests were carried out. An independent t-test was performed to check whether the engagement scores between Group A and B differ at the timepoints T0, T1, and T2, and after the PSD and non-PSD module. The dependent t-test was performed to see

whether the engagement scores differ within a Group at different time points. To ensure correctness of the analysis, one row had to be deleted from the dataset, due to a missing value. Therefore, the dataset included five data points. To perform the t-tests, the assumption of normality was checked with the Shapiro-Wilk normality test, which was chosen because it was used for small sample sizes. Since the p-value was $p = .325$, it was assumed that the data was normally distributed. To check for the assumption of equal variance between the non PSD module and the PSD module, an f-test was conducted. As $p = .683$, it is assumed that the variances are of equal variance, and do not differ significantly between the two data. However, the assumption of equal variance was met, the researcher decided for the independent t-test to do a Welch's t-test. As it is more appropriate for handling small datasets.

Further, the researcher performed a thematic analysis out of the eye-tracking analysis and the think-aloud session to answer RQ1. For the eye-tracking analysis heatmaps were derived. Thereby, a heating point was set on the page every time a participant fixated on an area to check the relative frequency. If a participant looked at an area several times, the heatmap demonstrates it with a red area. On the contrary, if the participant only fixated on a certain point a few times, the area is green. A heating point on the border of the page demonstrates that the participant looked elsewhere, instead of the screen. From the think-aloud session, the researcher analysed whether what participants stated could be related to the heatmap. If patterns of two participants were observed, the researcher was able to form a code.

Further, a thematic analysis was chosen to identify reoccurring themes regarding personality traits, PSD features and their influence on engagement levels. The themes emerged out of patterns that were observed within the semi-structured interviews. Only four participants could be used for the eye-tracking and think-aloud analysis, due to missing data, caused by technical issues.

Lastly, for the first research question, another thematic analysis was performed, based on the semi-structured interview. The themes emerged because the researcher derived patterns, based on perceptions of different features that were mostly liked or disliked, and barriers for liking certain PSD features. After finding codes they were merged into broader categories.

To answer the second research question, whether personality traits are related to engagement scores within the PSD module, the two previous thematic analyses were used to gather further insights into the relationship. Additionally, a Spearman's rank correlation was performed for the personality traits and each dimension of engagement. The assumptions of ranked values and independent observations were ensured. Moreover, the third assumption, whether the variables have a monotonic relationship, could not be assured for every variable. Therefore, for all variables the relationship visualised, and the nature of the relationship was explained descriptively, in addition to the statistical outcomes. Consequently, five data points were included, due to a missing value.

Results

Descriptive Statistics

The mean engagement scores of the participants in Group A, at the time point T0, was $M = 2.59$ ($SD = 0.05$) (T0). After the non-PSD module (T1) it was $M = 2.15$ ($SD = 0.52$). Further, after the PSD module (T2) the mean engagement score was $M = 2.22$ ($SD = 0.63$). For Group B the mean score before conducting the modules (T0) was $M = 2.67$ ($SD = 0.42$). After having conducted the PSD module (T1), it was $M = 2.89$ ($SD = 0.05$). Afterwards (T2), it was $M = 3.22$ ($SD = 0.25$).

On the Mini-IPIP, participants overall scores were for Extraversion $M = 2.79$ ($SD = 1.09$), for Agreeableness $M = 4.62$ ($SD = 0.47$), for Neuroticism $M = 3.33$ ($SD = 1.16$), for Openness $M = 4.17$ ($SD = 0.74$), and for Conscientiousness $M = 3.16$ ($SD = 0.68$).

Inferential Statistics

For the dependent t-tests within the groups the results are as following. Group A, the score between T0 and T1 is $T(1) = 1.51$, $p = .27$. It showed no significant difference between the baseline engagement and the engagement score after the first module, the non-PSD intervention. The scores of T0 and T2 are $T(1) = 0.43$, $p = .74$. There was no difference between the baseline engagement and the PSD intervention found. For the measurement points T1 and T1 the outcome is $T(1) = -0.08$, $p = .95$, implying no difference between the non-PSD and PSD module. For Group B the scores are – for the T0 and T1 values – $T(1) = -1.00$, $p = .42$. There was no significant difference between expected engagement and engagement after the PSD module. For expected engagement and engagement after the non-PSD module, there was a significant difference, $T(1) = -6.91$, $p < 0.05$. The mean scores of the non-PSD module significantly differ compared to expected engagement. For points T1 and T2, $T(1) = -0.96$, $p = .44$, there was no significant difference found between the non-PSD module and the PSD module.

For the independent t-tests between Groups there was a significant result between the non PSD module between Group A and Group B $T(2.33) = -7.20$, $p < 0.05$. Between Group A and Group B's PSD intervention there was no significant difference $T(1.25) = -0.95$, $p = .49$. There was a second significant difference between engagement at all time points between Group A and Group B $T(3.98) = -3.03$, $p < 0.05$. At the time point T0 the two groups do not significantly differ $T(2.24) = -0.28$, $p = .81$. Also, for the time point T1 the groups do not differ $T(2.10) = -3.16$, $p = .08$. Lastly, for the time point T2, there was also no statistically significant result $T(1) = -1.17$, $p = .45$.

The second research question was whether personality traits (conscientiousness, extraversion, agreeableness, openness, and neuroticism), influence engagement levels (cognitive, affective, behavioural), within a PSD intervention. To answer this question, Spearman's rank correlation was conducted to assess the relationship between each trait and dimension. The relationship between conscientiousness and all dimensions of engagement is not monotonic, as the engagement values decrease initially and then increase. The inconsistency in direction weakens the correlation. As the outcomes for the cognitive dimension is $r(3) = -0.05$, $p = .93$, for the affective dimension $r(3) = -0.05$, $p = .93$, and for the behavioural dimension $r(3) = -0.36$, $p = .55$, the rank correlation evolves for all around zero, suggesting no monotonic relationship between conscientiousness and engagement, for the relationship between agreeableness and cognitive engagement. The analysis showed a strong negative relationship between the two variables, $r(3) = -1$, $p < 0.001$, which was statistically significant. This result suggests that as levels of agreeableness increase, levels of cognitive engagement decrease in a perfectly monotonic manner within this dataset. Between the relationship of agreeableness and affective engagement, there was a strong negative correlation, $r(3) = -0.92$, $p < 0.001$. This suggests a strong negative relationship between the two variables. Moreover, the relationship between agreeableness and behavioural engagement was $r(3) = -0.68$, $p = .322$, suggesting no significant relationship between the two variables. From the graph (see Appendix E) there is no monotonic relationship, as the graph decreases first, then increases, and decreases again. For the relationship between extraversion and all dimensions of engagement, the graph was similar; it first decreases, then increases and decreases again. The outcome for the cognitive dimension was $r(3) = 0.56$, $p = .32$, for the affective dimension $r(3) = 0.31$, $p = .61$, and for the behavioural dimension $r(3) = -0.15$, $p = .80$. Thus, the rank correlations are overall similar to zero and this suggests no monotonic relationship between conscientiousness and engagement. The relationship between openness and all engagement dimensions was visually similar, the graph decreases first and then

increases, additionally for behavioural engagement, in the end, it decreases again. For the cognitive dimension the outcome is $r(3) = -0.05$, $p = .93$, for the affective dimension $r(3) = -0.05$, $p = .93$, and for the behavioural dimension $r(3) = -0.36$, $p = .55$. For the variable openness the rank correlation is close to zero which suggests no monotonic relationship between conscientiousness and the different engagement dimensions. Neuroticism and cognitive engagement had no significant outcome, $r(3) = -0.87$, $p = .06$, however, there is a monotonic negative relationship that can also be seen from the visualisation. This monotonic relationship occurs for neuroticism and affective, and behavioural engagement as well, whereas the affective engagement is $r(3) = -0.65$, $p = .24$, and for behavioural engagement it is $r(3) = -0.65$, $p = .24$. This suggests no significant relationship between neuroticism and engagement scores overall, but the relationship is a monotonic one.

Qualitative Analyses

Thematic Analysis Based on Eye-Tracking and Think-Aloud Protocol

The thematic analysis consists of the themes *Disliked PSD features* and *Positively perceived and liked PSD features*. Overall, the responses of four participants were included, due to missing data from the eye-tracking and think-aloud sessions caused by technical issues. An overview of the two themes and four codes can be found in Table 2.

Table 2

Themes and Codes of the Thematic Analysis of Eye-tracking and Think-Aloud Protocol

Themes	Codes	n	%
Disliked PSD Features	General Dislike and Confusion About PSD Feature Normative Influence	3	75
	PSD Feature Expertise Received Disinterest and Dislike	4	100
Positively Perceived and Liked PSD Features	PSD Feature Tailoring Received Positive Feedback	2	50
	PSD Feature Similarity Made the Module Feel More Positive	2	50

Note. Two themes and four codes emerged of the analysis. Frequencies (n) and percentages (%).

Theme 1: Disliked PSD Features

The theme consists of the code's *General dislike and confusion about PSD feature normative influence* and the *PSD feature expertise received distrust and dislike*.

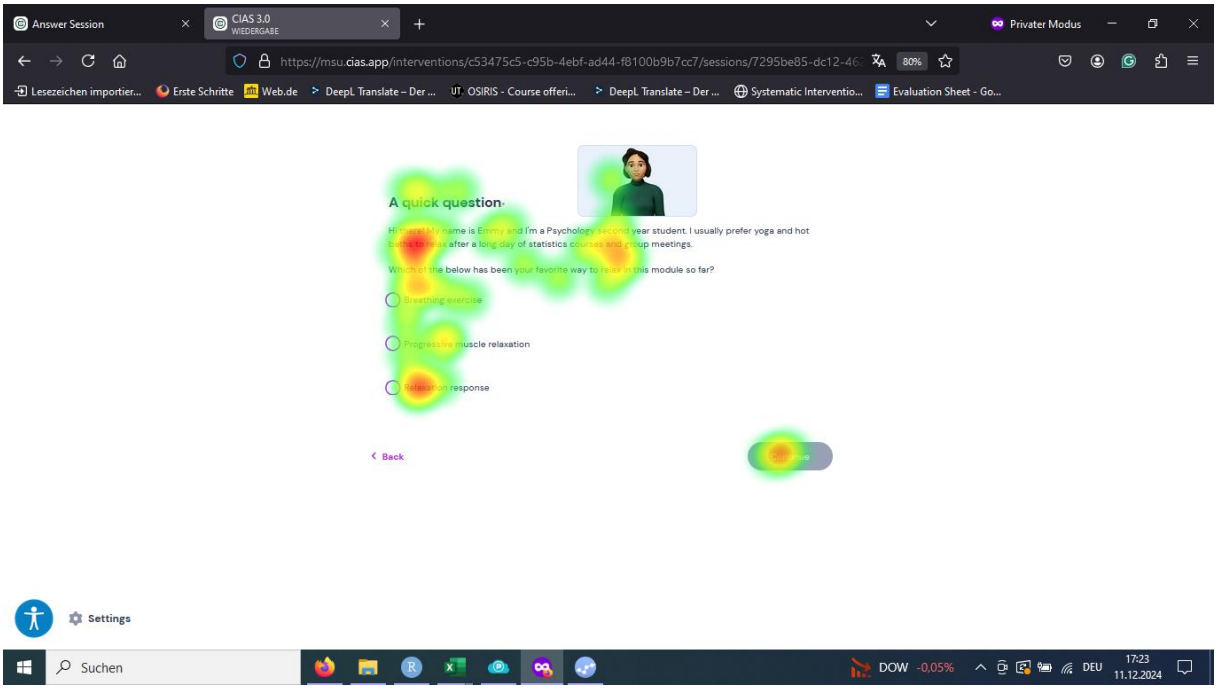
Code 1: General Dislike and Confusion About PSD Feature Normative Influence

Three out of four participants expressed a general dislike for the *Normative Influence* feature, which included the animated character. They reported that it made no difference, whether the character was portrayed as a Human Resource Manager in the non-PSD module or a student in the PSD module. One participant mentioned disliking the character: *"... being able to choose between the three options was great, but I still didn't like the inclusion of the lady speaking. I don't know why but I really didn't like it. It wouldn't make a difference to me*

if it was there or not, basically." Two participants found the character confusing and as a result, they did not pay attention to the feature: *"I was a bit confused because she started speaking randomly… It didn't make it any more fun … she started speaking out of nowhere… and it doesn't really complement the whole thing well because it was so abstract for telling something … ."* Overall, participants disliked the element regardless of whether the character was a student or not, leading them to ignore it. This behaviour is evident in heatmaps, as shown in Figure 3, from Participant 5. While heatmaps of other participants showed more red points on the character, they also stated disliking the element.

Figure 3

Heatmap of PSD Module, Normative Influence Feature, Participant 5



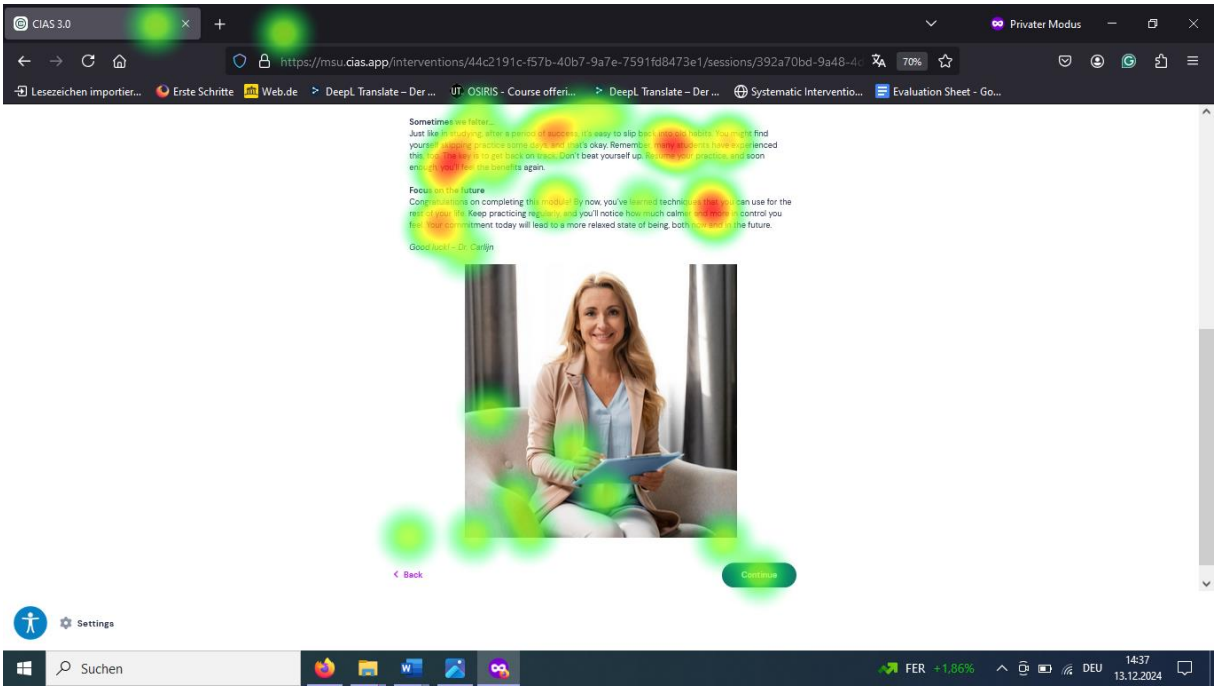
Note. The participant barely looked at the character, the most fixation counts were at the text and the three answer options.

Code 2: PSD Feature Expertise Received Disinterest and Dislike

All four participants expressed disinterest and dislike regarding the inclusion of the expert picture, stating that it was unnecessary. The main reasons were confusion about the picture's purpose, a lack of connection to the person depicted, and no sense of reassurance from the feature. Participants believed the picture was intended to foster connection and reassurance, but it failed to achieve these goals. One participant remarked, *"Yeah, just I was a bit confused why there was a woman like a picture of her included… Because I don't think it would have been necessary."* The heatmap in Figure 4 showcases that the picture was often ignored. While some participants focused more on the face, they still reported disliking the feature or finding it unnecessary.

Figure 4

Heatmap of PSD Module, Expertise Feature, Participant 9



Note. The main fixation points were on the text. The expert picture received little attention.

Theme 2: Positively Perceived and Liked PSD Features

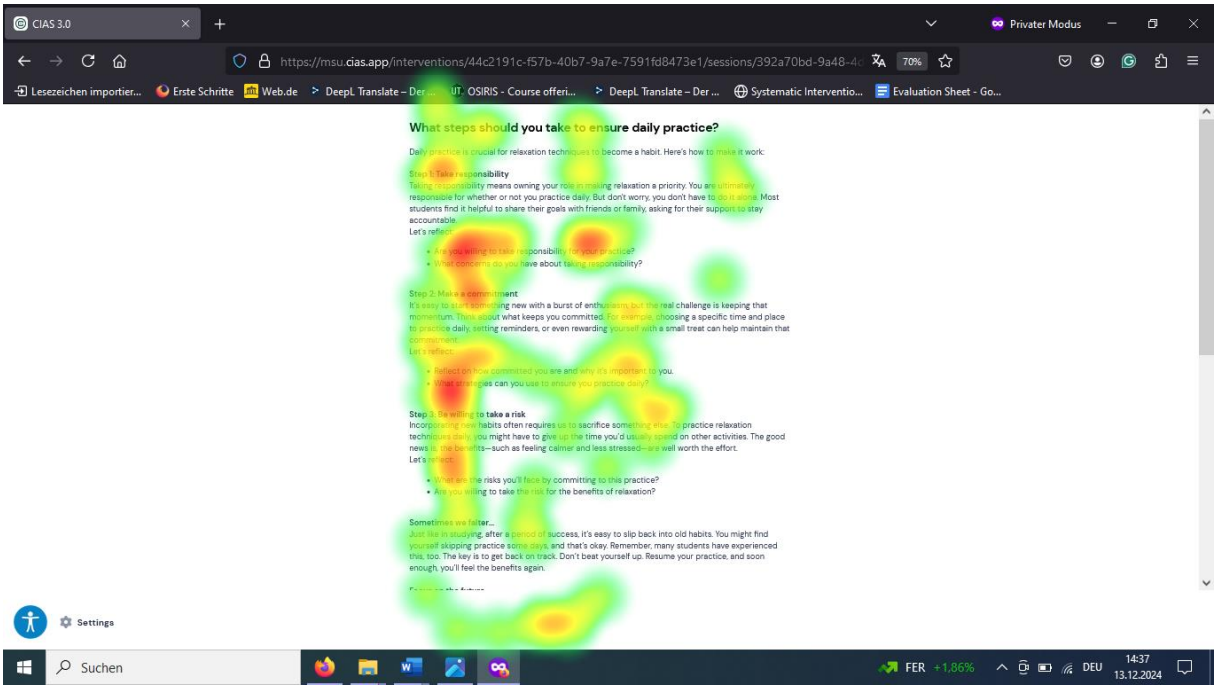
The theme consists of the code *PSD feature tailoring received positive feedback* and the code *PSD feature similarity made the module feel more positive*.

Code 3: PSD Feature Tailoring Received Positive Feedback

Half of the participants appreciated the intervention's student-targeted information, reflecting the tailoring feature. Additionally, the inclusion of tailored insights from other students within the module was well-received, as it allowed participants to connect with the content: *"I thought it was content-wise really strong… you got small bits of information, why you should know [that] and what impact it [has] on you… and all that you need [is there]."* The heatmap in Figure 5 shows that participants paid significant attention to the tailored information.

Figure 5

Heatmap of PSD Module, Tailoring Feature, Participant 9



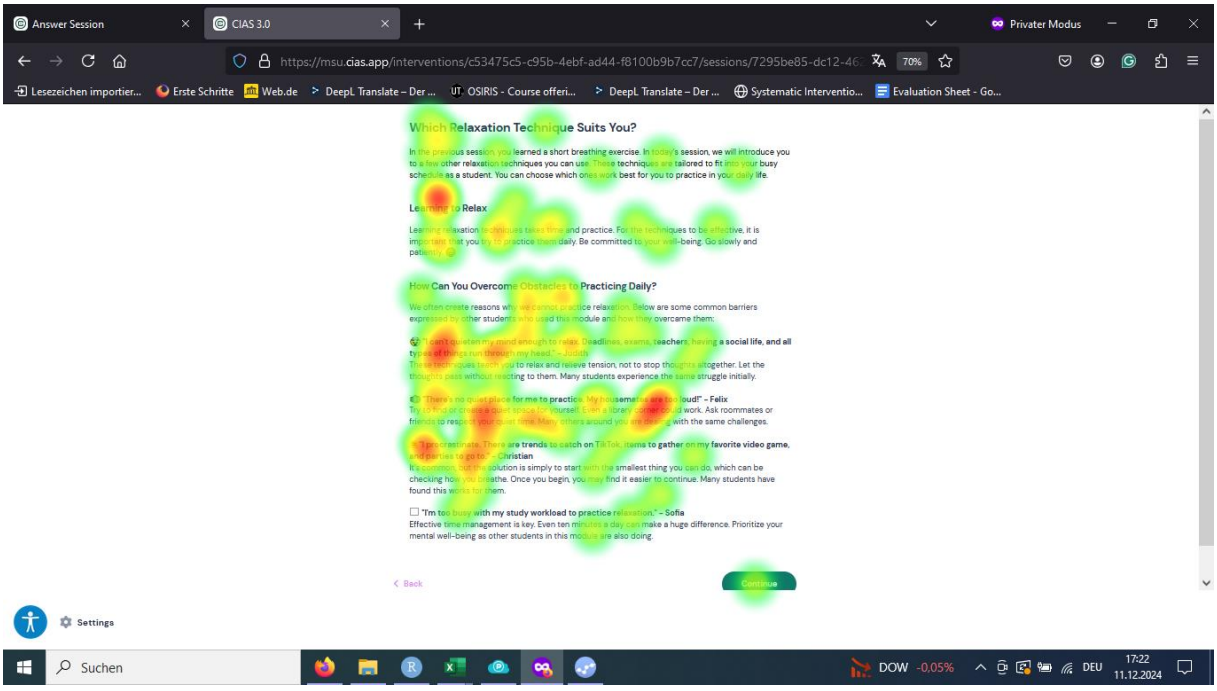
Note. The participant gave much attention to the information that were tailored to students.

Code 4: PSD Feature Similarity Made the Module Feel More Positive

Two participants expressed a preference for the inclusion of emojis, noting that they enhanced the overall experience by making it more positive: *"I think it's good that there is … the use of emojis … [it] is just more positive."* The heatmap in Figure 6 indicates that the emojis captured the participant's attention. However, heatmaps from other participants (not shown here) show that they seemed to prioritize the text instead of the emojis.

Figure 6

Heatmap of PSD Module, Similarity Feature, Participant 5



Note. The participant looked at the emojis more often.

Thematic Analysis – Interview

This thematic analysis will present the key findings from the six conducted semi-structured interviews. Three main themes were developed to clarify the relationship between, PSD and engagement, such as if personality influences this dynamic. The themes are *Influences on Cognitive Engagement*, *Engagement and Personality Influences*, and *Barriers and Improvements*. The themes and the codes are visualised in Table 3.

Table 3

Themes and Codes of the Thematic Interview Analysis

Themes	Codes	n	%
Influences on Cognitive Engagement	Tailoring	4	66.67
	Self-monitoring	3	50
Engagement and Personality Influences	Influences on Overall Engagement	4	66.67
	Perceptions of Personality Influencing Engagement	4	66.67
Barriers and Improvements	Barriers to Liking Normative Influence and Expertise	4	66.67
	How to Better Implement Normative Influence	4	66.67
	The Need for Personalisation	4	66.67

Note. Three themes and eight codes emerged of the interview analysis. Frequencies (n) and percentages (%).

Theme 1: Influences on Cognitive Engagement

This section explains which features influenced cognitive engagement and why, based on participants' feedback. The relevant codes are *Tailoring* and *Self-monitoring*.

Code 1: Tailoring

The PSD feature tailoring was generally liked by four of the six participants. Tailoring was integrated into the intervention through various elements, including a tailored question, language adjustments, and a step-by-step guide for habit building. Participants found the tailored question engaging, since it prompted reflection on their progress and preferred relaxation techniques, encouraging deeper thinking and memory activation: *"Especially the last question where I had to pick which exercise I liked best, because I had to reflect what I did in the first session and also in the second session, and really try to remember … which parts I like better than the others and had to … decide which parts are kind of more worth than the others that I liked best."* After answering, participants received tailored information based on their choice, which they appreciated for enhancing their knowledge: *"And then it also gave additional tips, which I also didn't know … that was great."* Overall, participants valued the feature for increasing their attention and providing new information.

Tailoring to the language involved adjusting information to students' lives, a facet participants appreciated for its realism and relatability. *"I feel like just in the first one or two pages, just because they were quite high quality in terms of […] relatability … [I thought] oh, this is something you might encounter, and this is something that might help… That kind of gives it credibility for the rest of it."* Because the information was directly relevant to students, participants felt the intervention was worth their attention, addressing their cognitive engagement. They also found the intervention useful, aligning with the cognitive dimension

of engagement related to attention and usefulness. Additionally, participants noted the tailored information's realism as a key factor in enhancing engagement: *"I did like the beginning with what the other students said… I thought it was pretty realistic."* Realistic advice, which students find useful, further supports cognitive engagement.

The third integration of tailoring mentioned by participants was the step-by-step guide, which was seen as very useful, inclusive, and the most comprehensive element. The guide included several questions that helped participants feel responsible for their journey and reminded them of their goals and motivations: *"And especially the step-by-step plan with the dips. It's the most expansive thing for the full [positive habit] … Plus how to build that habit yourself and well support it."* Participants were cognitively engaged, believing the "guidelines" would be the most helpful for achieving their goals.

Code 2: Self-monitoring

Self-monitoring was not initially planned as a feature in this study; however, half of the participants found the reflection opportunities to be very, or even the most, helpful and engaging. As a result, this feature is included in the analysis. Participants stated that writing down their goals and reflecting on their performance deepened their engagement: *"Yes, I did [feel engaged]. Especially when the little boxes started popping up when you should type a little bit in what [and] how you felt during the exercise and if you were actually able to focus … or if you did get distracted."* They also saw it as a way to monitor their progress, with most participants describing it as the most useful feature: *"I think the writing down in the boxes [was the most motivating]. I feel like it's useful to write something down and … because there is a box, it kind of activates you to do that. And when you start doing it, you start thinking about it more deeply… I think it was very very good."* Hence, writing down their aims made participants feel responsible for achieving them, which they found helpful and motivating.

Theme 2: Engagement and Personality Influences

The theme includes the code *Influences on overall engagement*, which describes additional features and elements affecting engagement, and the code *Perceptions of personality influencing engagement*.

Code 1: Influences on Overall Engagement

Four of the participants mentioned additional elements that influenced their overall engagement. For example, the Similarity feature, due to the inclusion of emojis, was mentioned by three participants as a factor that increased engagement. *"I was surprised … the emojis directly made me more engaged."* Overall, the text was perceived as "much better" when it included tailored information and emojis.

Two participants mentioned that one module had a variety of features, while the other did not. They noticed that the module with multiple features held their attention longer and increased engagement. *"And there were more different things overall… So, it was kind of keeping your attention more."* This relates to cognitive engagement through attention and the perceived usefulness of multiple features: *"There was a combination of media, whereas you have materials of course, with reading, but you have the use of pictures, the use of the video with the audio … that kind of usage of multiple different channels to enter information is usefully [and] helps you to stay engaged."* The presence of multiple features contributed to greater engagement.

Code 2: Perceptions of Personality Influencing Engagement

Four participants reported possible connections between their personality traits and their perception of the intervention. Two participants mentioned that their general curiosity, linked to the personality trait of openness, influenced their engagement in the intervention. However, they also noted that when they encountered familiar information, they lost interest and did not find it informative, attributing this to their personality: *"Yes, definitely because*

I'm an open person. I like to try new things and I'm open to also, getting new information about stuff as well… When I already know some stuff, even though I was a little biased because I knew a little bit about breathing exercises, I still try to get more information about it and not block, kind of."

One participant reported a general distrust, which led to the PSD features not affecting their engagement: *"Absolutely, I don't believe anything the app says, therefore, the design features didn't make any difference kind of, that's me, that's just my distrust with this thing, it has nothing to do with the design or content."*

Another participant suggested that the increased interaction with people in the PSD module made it more engaging: *"Well, like I said, I also really like people. Even though I'm introverted, I still like people. So I think that's why I found the second session also a bit more engaging because there was more engagement with other people, kind of, you know."*

Theme 3: Barriers and Improvements

The theme barriers and improvements include the code *Barriers to liking normative influence and expertise*, *how to better implement normative influence*, and *the need for personalisation*.

Code 1: Barriers to Liking Normative Influence and Expertise

Four participants expressed general dislike for the normative influence feature (the character), and the expert picture, which led to cognitive disengagement, as they lost attention and interest there. Participants lost interest, found the features confusing, or simply did not like them. The features felt unnatural, AI-generated, and participants were confused by them: *"We had like a picture of a therapist in there that also kind of stood out, but because I thought it was kind of weird and it didn't feel very natural. I debated if it's AI-generated, it probably is… but it was also this character that I've never seen before…"* It became clear that

participants did not like unnatural elements within the intervention. According to the participants, the expertise feature could benefit from referencing a real person, such as a national researcher, known to the target group. Additionally, regarding the animated character Louise, participants felt that the unreal nature of the character made the feature feel impersonal: *"I just wanted to say that maybe experience from different people, but like real people. Not the cartoons because the cartoons seem like …impersonalized."* Overall, participants preferred real humans in interventions, and anything that felt unnatural or fake led to disengagement.

Code 2: How to implement Normative Influence

Four participants suggested improvements to the feature. They mentioned that the character should start speaking immediately, as many were confused when she began speaking after a delay while they were reading the text. The feature should feel more natural, with participants preferring real people over the computer-generated character. Additionally, the character should explain which relaxation technique helped them achieve their goal, as the current vague information was perceived as unnecessary and led to disengagement: *"If this character would have told me, oh, I do this in my life to do this and that, then it would be more interesting."* Lastly, if the character were to remain, it should be better integrated, as its static appearance was a drawback.

Code 3: The Need for Personalisation

Four participants expressed a desire for more personal elements in the intervention. Most suggested including mood scales or quizzes to help them stay focused and improve their performance on exercises. One participant noted: *"I think lack of interaction, like maybe sometimes scales to indicate how you're feeling. Maybe honestly, even if it did absolutely nothing, it would feel nice to have a scale at the beginning of a session to check how you're feeling. Even if it didn't affect anything, it just makes you feel like this is, for me, this*

personalized." Two participants would have liked an overview of exercises, allowing them to choose methods and receive further information on their choices, as well as more exercises for each technique (e.g., various breathing exercises): *"Preferences will be a good idea ... that you can kind of select broader topics, that would include like more subtopics that were more precise. So, I liked the overview and to have more techniques in the [intervention]."* They felt that this approach would make the intervention feel more tailored to their needs and preferences, enhancing their overall engagement.

Discussion

The following will discuss the overall results found in this study before the main points will be discussed. Starting with the purpose, this study was conducted to explore whether the inclusion of PSD features in an online intervention leads to higher engagement in university students, and whether there is a relationship between personality traits and engagement. Against expectations, there was no quantitative effect found for higher engagement scores when including PSD features. Only for the non-PSD module between Group A and Group B, there was a significant difference, with Group B having higher engagement scores. Further, there was a significant difference within Group B, comparing the time points for the expected engagement and after the second module, the non-PSD module, where the engagement scores after the non-PSD module were significantly higher. Additionally, regarding the relationship between PSD features and engagement, through the qualitative analysis and the think-aloud session, some patterns evolved that, the module with the PSD features is more engaging. Likewise, due to participants, the most engaging PSD features are tailoring, and self-monitoring. Participants were able to relate to the intervention through the tailored language and tailored information.

Moreover, participants liked the feature self-monitoring, as they had the opportunity to reflect on their experience. In addition, participants found this particularly useful. However,

the feature was not originally planned to be included as one. In comparison to Group A, participants from Group B reported generally higher engagement scores, also for the non-PSD module. Not only the quantitative, but also the qualitative analysis displayed this. In the semi-structured interview, participants from Group B reported in general more positively about the non-PSD module than participants from Group A did.

To answer the second research question, if there is a relationship between personality traits and engagement, a significant monotonic negative relationship was found between agreeableness and engagement through the quantitative analysis. Further, a monotonic negative relationship was found between neuroticism and engagement, which did not demonstrate statistical significance. The eye-tacking analysis was not able to provide insights into this relationship. From the qualitative analysis one could see light patterns and subsequently, conscientiousness, openness, and agreeableness, could be related to engagement. Neuroticism could have a negative impact on engagement, due to a general distrust. Nevertheless, the only overlap from the analyses was that neuroticism could have a negative impact on engagement.

The first main point is that the analysis revealed that participants in Group B demonstrated significantly higher engagement overall compared to Group A. Quantitative findings showed a notable difference in engagement, with Group B consistently scoring higher. Interestingly, when comparing the non-PSD modules across both groups, engagement remained higher for Group B. This suggests the presence of an ordering effect or bias, as Group B began with the PSD module. Stibe and Oinas-Kukkonen (2014) highlight that users' perceptions of a system's persuasiveness and quality strongly influence engagement. In this study, starting with the PSD module may have positively impacted Group B's engagement levels. This positive effect appeared to carry over into the second module (non PSD), suggesting that early exposure to the PSD features established a baseline of favourable

impressions that persisted throughout the intervention. Qualitative data from interviews further supported these findings, with Group B participants reporting more positive thoughts and feelings about both modules, compared to Group A. This aligns with the quantitative results, reinforcing the idea that the PSD module's initial impact shaped subsequent experiences. The higher engagement scores for Group B's non PSD module may also be explained by familiarity with the design. As Perski et al. (2017) have noted, familiarity fosters comfort, which in turn enhances engagement. It is plausible that Group B's positive experiences with the PSD module created a sense of comfort that extended into their interaction with the second, non PSD module. The ordering effect in combination with the qualitative results, that the PSD modules were more engaging for participants provides evidence, therefore, this study found that PSD features play a significant role in enhancing engagement with digital mental health interventions. Likewise, the eye-tracking and interview analysis confirmed this, showing that participants from both groups generally reported more positive perceptions of the PSD modules. However, the higher engagement observed in Group B highlights the importance of introducing PSD features early in an intervention to maximize their impact.

The second discussion point is that this study identified tailoring and self-monitoring as the most well-liked and useful PSD features for enhancing user engagement, aligning with prior research and expectations (Borghouts et al., 2021). These findings reinforce the notion that PSD features can significantly improve engagement by addressing users' needs and preferences. Borghouts et al., (2021) highlighted two key facilitators of engagement: the perceived relevance and fit of the intervention for the target group, and the perception of its usefulness. Consistent with these findings, participants in this study reported feeling more understood and able to relate to the PSD modules, particularly through the feature of tailoring. Tailoring fostered affective engagement by increasing positive emotions toward the module and enhancing participants' perception of the intervention's quality and relevance. For

example, participants noted that the PSD module, designed specifically for students, provided information that felt useful and highly applicable to their needs. Similarly, the self-monitoring feature was frequently described as the most useful. This highlights the critical role of cognitive engagement - characterized by active processing and reflection - in fostering meaningful interaction with DMHIs. This finding is in line with literature, as Gan et al., (2022) explain that features that fall into the technology-supported strategy appear to increase engagement, which was the case with the two features. These findings underline that the cognitive dimension of engagement emerged as the most significant and impactful in this study. Further literature suggests that, to understand engagement and the influence of PSD features, it may be most effective to focus on the features participants find most useful (Wu et al., 2021). Participants were most drawn to features that encouraged active thought and reflection, demonstrating that usefulness and relevance are necessary, at least for this thesis, for maximizing engagement in digital interventions.

The third main finding revolves around the implementation of PSD features and barriers to engagement. Kelders and Van Zyl (2020) emphasize that how content is delivered plays a crucial role in influencing user engagement, particularly through aesthetics and functionality. These factors impact the emotional connection users form with an intervention. This perspective aligns with the findings of the present study, which revealed that certain PSD features were disliked, due to their implementation. This raises the broader question of how PSD features should be integrated to maximize their effectiveness. The qualitative analysis, supported by eye-tracking data, highlighted that features participants disliked were often ignored. For instance, the expertise feature was criticized for being aesthetically unappealing and feeling unnatural. Participants described the expert image as “weird” and speculated that it might have been AI-generated. They noted that the image did not foster a sense of connection, likely because the expert was unfamiliar to them. These reactions are consistent with Perski et al.'s (2017) claim that familiarity in design influences engagement. It can be

inferred that familiar design features, such as well-known experts, might positively affect user engagement. Similarly, the animated character representing the normative influence feature was poorly received. Participants reported that the character evoked discomfort and seemed unnatural, further detracting from their engagement. Familiarity appears to play a role not only in the overall design but also in the specific design features. Familiarity with the characters or experts presented in the intervention could enhance users' emotional connection and engagement. Functionality was another key factor affecting user perceptions. Many participants expressed dissatisfaction with the animated character's implementation, describing it as ineffective. This aligns with Kelders and Van Zyl's (2020) assertion that functionality is critical for user satisfaction and engagement. Poor implementation of the normative influence feature may have contributed to its negative reception. In summary, the study underscores the importance of delivering PSD features in a way that feels natural, familiar, and functional. Design choices that fail to meet these criteria risk disengaging users and diminishing the intervention's overall effectiveness.

The fourth main point reflects the relationship between personality traits and engagement. Kelders et al., (2020) argue that engagement should not be directly correlated with personality traits, as engagement represents a distinct construct. Similarly, Orji et al., (2017) found that certain personality traits, such as neuroticism and openness, are less responsive to persuasive system design (PSD) features. In particular, neuroticism showed no significant relationship with engagement, and openness was identified as the least responsive to persuasive strategies. On the other hand, agreeableness and extraversion were found to be the most responsive to PSD strategies. This is in contrast to the current study, as here, the results suggest that there is a negative relationship between engagement the personality trait agreeableness. However, the findings from this study do not align entirely with the conclusions of Orji et al., (2017). For instance, while neuroticism may not be directly related to engagement with specific PSD features, the trait could indirectly affect engagement

through a general distrust of interventions, as observed in participants with high neuroticism scores. This suggests that personality traits might influence engagement through mechanisms other than direct responsiveness to PSD features. It is also important to note that Orji et al., (2017) study utilized different PSD features compared to this research. This variation in design elements may partially explain the discrepancies in findings. Moreover, engagement is a multifaceted construct influenced by numerous factors beyond personality traits and PSD features. These unknown or unmeasured factors could contribute to the complex relationship between personality and engagement in digital mental health interventions.

In conclusion, while personality traits may play a role in shaping user engagement, their influence is nuanced and contingent on other factors, including the design and delivery of the intervention. Further research is needed to explore these interactions and better understand the predictors of engagement.

Strengths and Limitations

A clear strength of the study was the mixed methods design. Whereas the quantitative analysis was not able to find significant results between higher engagement scores of the module with and without PSD features, except for one significant result, the qualitative analysis was able to provide more details and in-depth insights into the relationships. It was possible due to the interview to find out that PSD features have an influence on engagement scores and which features encouraged that relationship.

Further, the eye-tracking analysis underlined that relationship; features participants liked received much attention and PSD features that were strongly disliked were rather avoided. On the other hand, regarding personality traits and engagement it was the other way around, the quantitative analysis was able to back up the qualitative analysis. Considering the qualitative analysis, there were solely debatable connections found between personality traits

and engagement. The quantitative results helped to provide some further insights, as strong monotonic relationships were found between certain traits and engagement levels.

A limitation of this study is that there were some misconceptions about how certain design features were perceived by participants. For example, there were some reflection boxes provided, and participants liked those very much and considered them as almost the most helpful element. Therefore, this was taken into the analysis as the feature of self-monitoring. However, the feature was not included in the eight originally planned features. It naturally emerged from the data. Further, there were some general overlaps with the design features, e.g., normative influence and tailoring. The tailored information for students included another positive example from virtual students, therefore, one could also see this as the feature of normative influence, since some participants felt a certain peer pressure due to that. Additionally, the animated character, being the feature normative influence, also occurred in the non-PSD feature. This could be a possible influencing point as to why participants perceived the modules as very similar overall.

Another limitation of this study is that it does not fully replicate a real-life scenario, as the target group consisted solely of students. This makes it challenging to determine how PSD features might influence engagement in a real-world context, particularly in a digital mental health intervention (DMHI) that participants are required to complete. Additional variables, such as mental health disorders, could influence engagement and present barriers for real patients, which were not accounted for in this study.

Despite these limitations, it is assumed that the underlying mechanisms driving attention and interest observed in this study are similar to those that would operate in real-life scenarios. Furthermore, it is believed that insights regarding the implementation of PSD features and the barriers to engagement can be generalized to a broader population beyond the

student sample. Future research should aim to validate these findings in more diverse and clinically representative settings to strengthen their applicability.

Implications for Future Research

Future studies should investigate the impact of module sequencing on engagement. This study's findings suggest that introducing PSD features early in an intervention can establish a positive baseline for user experience, potentially influencing subsequent engagement with non-PSD modules. Research should explore whether this effect is consistent across different interventions and target populations. Further, long-term studies are needed to assess whether the positive effects of early exposure to PSD features remain over an extended period. This could help determine whether familiarity and comfort with the design continue to enhance engagement or if the effects diminish over time, as Perski et al. (2017) explain. Given that participants in this study reported discomfort with unfamiliar experts and animated characters, future interventions should consider using familiar, relatable figures to enhance emotional connection. Studies should investigate how different user groups respond to familiar versus unfamiliar design elements. The evidence suggests that early integration of PSD features maximizes their impact. Researchers and practitioners should explore optimal placement strategies for PSD features within interventions to achieve the highest engagement levels. Using eye-tracking devices could aid the research, in e.g., experimental designs. It would be beneficial to investigate how design choices, such as the style, size, and presentation of characters or expert images, influence users' emotional connections and engagement with the intervention.

Besides, future digital mental health interventions (DMHIs) should emphasize incorporating tailoring and self-monitoring features. These features were identified as key drivers of engagement, fostering both affective and cognitive connections with the intervention. Tailoring should ensure content relevance and applicability to the target

audience, while self-monitoring tools should encourage reflection and active participation. Research should explore innovative ways to enhance the tailoring feature, such as integrating adaptive algorithms that dynamically adjust content based on user behaviour or preferences, further increasing perceived relevance and engagement.

While affective engagement is crucial for creating positive emotional connections, this study suggests that cognitive engagement, through active reflection and perceived usefulness, is the most impactful dimension. Future research should explore how to balance these engagement dimensions to optimize outcomes for different user groups.

Another aspect for future research to focus on is the investigation on how personality traits, particularly neuroticism, agreeableness, and extraversion, influence engagement with digital mental health interventions. Since this study suggests that the relationship between personality traits and engagement may be more nuanced than previously thought, further exploration is needed to understand the indirect effects of traits like neuroticism (e.g., through trust or general attitudes toward interventions). Given that in the study of Orji et al., (2017) they used different PSD features than this research, future studies should replicate the findings using a broader range of PSD features. This will help determine whether specific PSD features interact differently with various personality traits and how these features influence engagement across different contexts. Lastly, further research should examine how the interaction between personality traits and the specific design and delivery of PSD features affects user engagement. This will help identify which features are most effective for users with different personality profiles and how interventions can be tailored to maximize engagement for a broader range of individuals.

In general, given that this study focused on a student population, future research should replicate these findings with more diverse groups, including clinical populations.

Future studies need to investigate how these implications apply across various demographic groups.

By addressing the aforementioned aspects, future research can deepen the understanding of how PSD features, personality traits, and intervention design influence user engagement. Ultimately, this will improve the effectiveness of digital mental health interventions. Focusing on these areas will allow future studies to build on the insights from this research, refining PSD feature implementation and ensuring they are both – effective and engaging – for a wide range of users. Consequently, exploring the complex relationship between personality traits and engagement can lead to more personalized interventions, maximizing their impact and enhancing their overall effectiveness.

Conclusion

To conclude, this study gave insight into the relationships between personality traits, the inclusion of PSD features, and their effect on engagement. The study suggested that students stated to be more engaged with the PSD intervention, however, this result is mainly supported by the qualitative analysis, and partly through the quantitative analysis. Referring to the beginning of this study, several PSD features were introduced, which might lead to the success and the effectiveness of a DMHI, mainly addressing the cognitive engagement dimension. This study was not able to find a relationship between personality and engagement that was supported throughout the quantitative and qualitative analysis. Further research should tackle this research gap of personality influences in the dynamic of DMHIs and engagement, to enhance the effectiveness of DMHIs further.

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Appendix A

Semi-Structured Interview

The semi-structured interview includes questions regarding participants engagement, features that might engage them, questions about personality, and final regards.

General Questions

1. How was your experience with the relaxation module?
    a. Can you tell us/me about your behavior?
    b. Can you tell us/me about your thoughts?
    c. Can you tell us/me about your feelings?
2. Have you ever thought about learning relaxation techniques or techniques to use to deal with stress before this study?
    a. Do you think this module helped you learn more about these techniques?
    b. Would you use the tools you learned in this module in your daily life?
3. Which session would you go back to if you could? Why?

Questions for the First Session

4. What stood out to you the most from the first session? Can you give us/me some examples?
5. Was there anything that made you interested in this session? Why?
    a. Were there any points where you lost interest? Why?
6. Were there any features or interactions that motivated you?
    a. Was there anything that made you feel unmotivated? Why?

7. What were your feelings going through this session? Why?

8. Is there anything about this session that you found useful? This can be about design features or any interactions, etc.

9. Did you feel engaged with this session? Why?

    a. (Yes) What made it engaging for you?

    b. What would make this session more engaging for you? Why?

Questions for the Second Session

10. What stood out to you the most from the second session? Can you give us/me some examples?

11. Was there anything that made you interested in this session? Why?

    a. Were there any points where you lost interest? Why?

12. Were there any features or interactions that motivated you?

    b. Was there anything that made you feel unmotivated? Why?

13. What were your feelings going through this session? Why?

14. Is there anything about this session that you found useful? This can be about design features or any interactions, etc.

15. Did you feel engaged with this session? Why?

    a. (Yes) What made it engaging for you?

    b. What would make this session more engaging for you? Why?

16. How would you describe your personality?

17. Do you think your personality impacted the way you interacted/perceived the system. If so, how?

Exit Questions

18. Is there anything you would like to discuss or share about the module that we did not talk about today?

19. Is there anything you want to share about your experience with the study?

20. Do you have any questions for us/me?

Appendix B

Mini International Personality Item Pool (Mini-IPIP)

The Mini-IPIP is a scale consisting of 20 items (see Table B1) to measure personality traits. Participants had to respond to each item on a 5-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Higher scores indicate a higher prevalence of the trait in a participant.

Table B1

Items of the Mini-IPIP

Item	Trait	Text
1	E	I am the life of the party.
2	A	I sympathize with others' feelings
3	C	I get chores done right away.
4	N	I have frequent mood swings.
5	I	I have a vivid imagination.
6	E	I don't talk a lot. (R)
7	A	I am not interested in other people's problems. (R)
8	C	I often forget to put things back in their proper place. (R)
9	N	I am relaxed most of the time. (R)
10	I	I am not interested in abstract ideas. (R)
11	E	I talk to a lot of different people at parties.
12	A	I feel others' emotions.
13	C	I like order.
14	N	I get upset easily.
15	I	I have difficulty understanding abstract ideas. (R)

16	E	I keep in the background. (R)
17	A	I am not really interested in others. (R)
18	C	I make a mess of things. (R)
19	N	I seldom feel blue. (R)
20	I	I do not have a good imagination. (R)

Note. E = Extraversion; A = Agreeableness; C = Conscientiousness; N = Neuroticism; I = Intellect/Imagination (Openness); (R) = Reverse Scored Item.

Appendix C

TWente Engagement with Ehealth Technologies Scale (TWEETS)

The TWEETS includes 9 items that measure engagement regarding a technology (the online module(s) in this study) (see Table C1). Participants indicated their engagement on a 5-Point Likert scale from 0 (Strongly Disagree) to 4 (Strongly Agree). A higher score indicates more engagement with the module on that dimension.

Table C1

Items of the TWEETS

Item	Dimension	Thinking about using the online module, I feel that:
1	B	The online module is part of my daily routine.
2	B	The online module is easy to use.
3	B	I'm able to use the online module as often as needed (to practice relaxation techniques).
4	C	The online module makes it easier for me to practice relaxation techniques.
5	C	The online module motivates me to practice more relaxation techniques.
6	C	The online module helps me to get more insight into practicing relaxation techniques.
7	A	I enjoy using the online module.
8	A	I enjoy seeing the progress I make in the online module.
9	A	The online module fits me as a person.

Note. B = Behavioural; C = Cognitive; A = Affective.

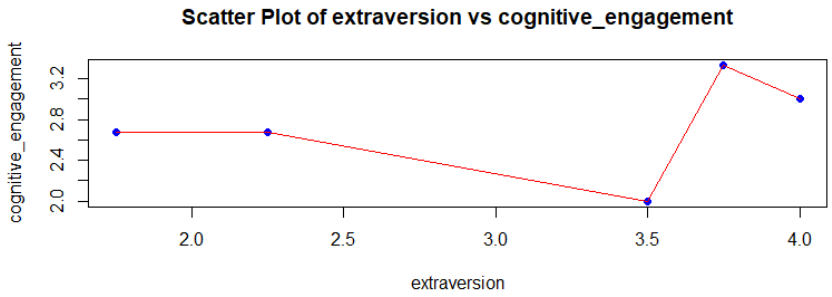
Appendix D

Spearman's Rank Correlation Visualisations of Relationships

The Figures (see Figure D1-D15) display the relationship between the personality traits and the dimensions of engagement.

Figure D1

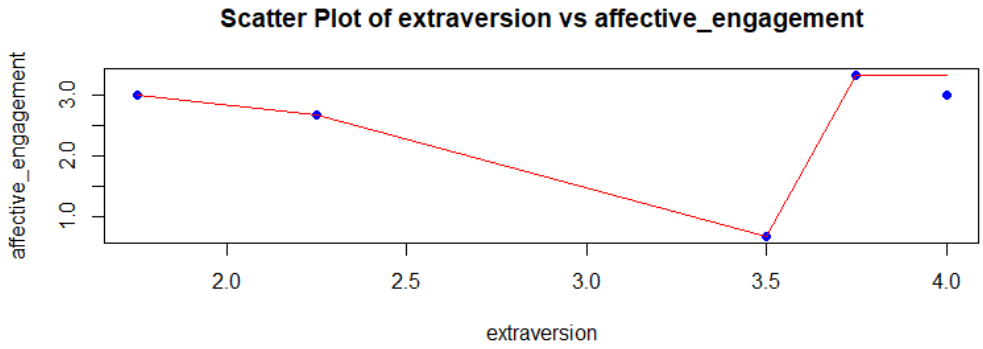
The Relationship of Extraversion and Cognitive Engagement



Note. No monotonic Relationship.

Figure D2

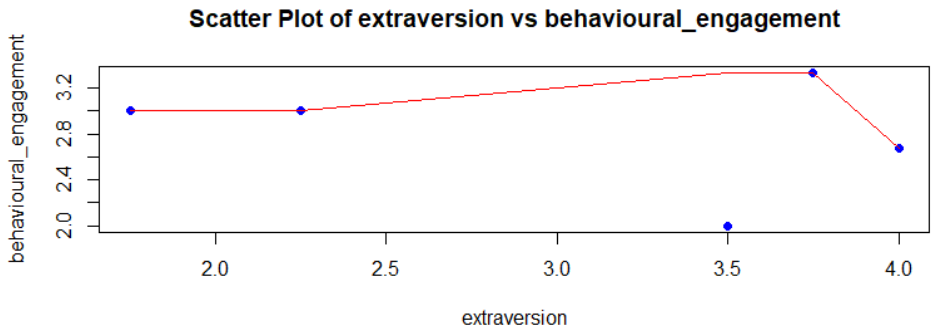
The Relationship of Extraversion and Affective Engagement



Note. No monotonic Relationship.

Figure D3

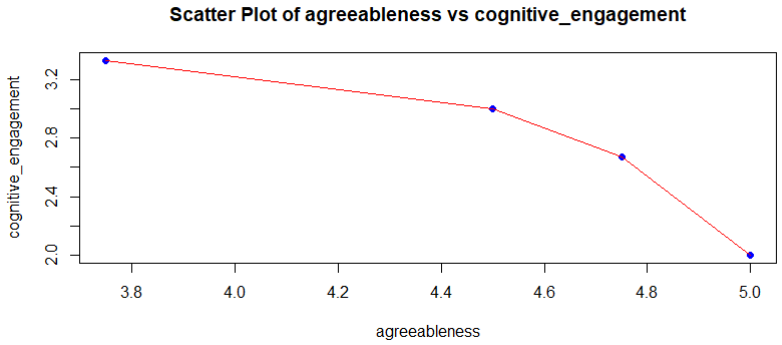
The Relationship of Extraversion and Behavioural Engagement



Note. No monotonic relationship.

Figure D4

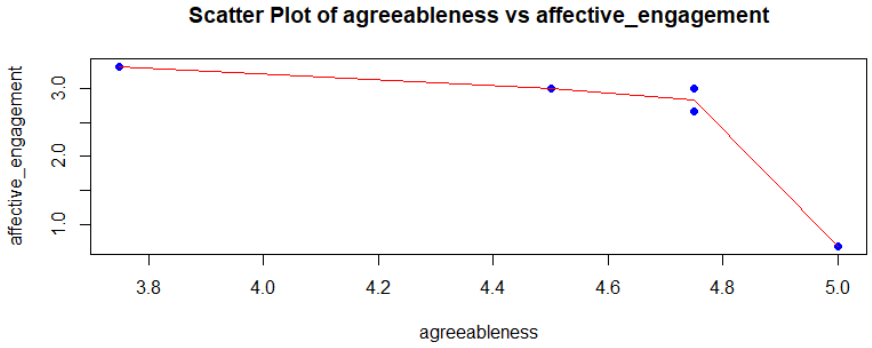
The Relationship of Agreeableness and Cognitive Engagement



Note. A monotonic negative relationship.

Figure D5

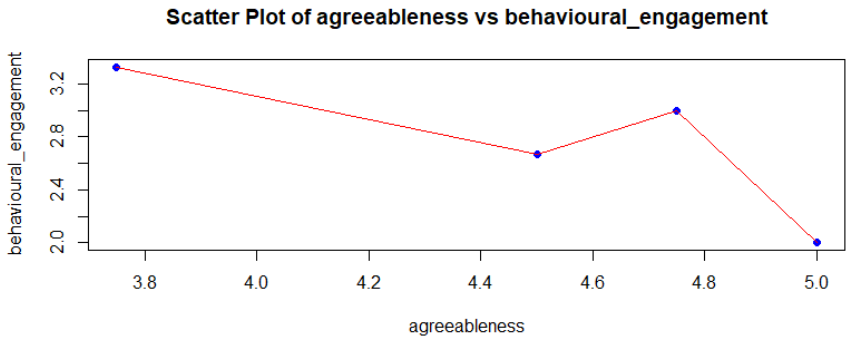
The Relationship of Agreeableness and Affective Engagement



Note. A monotonic negative relationship.

Figure D6

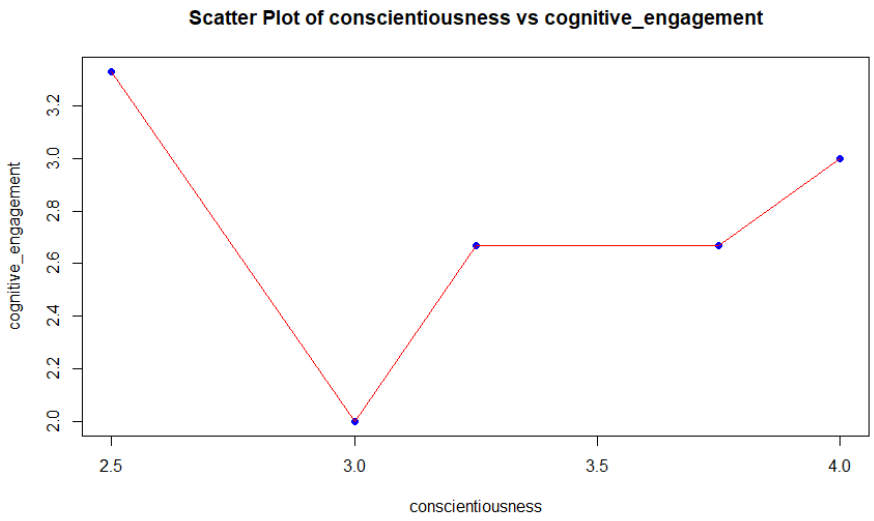
The Relationship of Agreeableness and Behavioural Engagement



Note. No monotonic relationship.

Figure D7

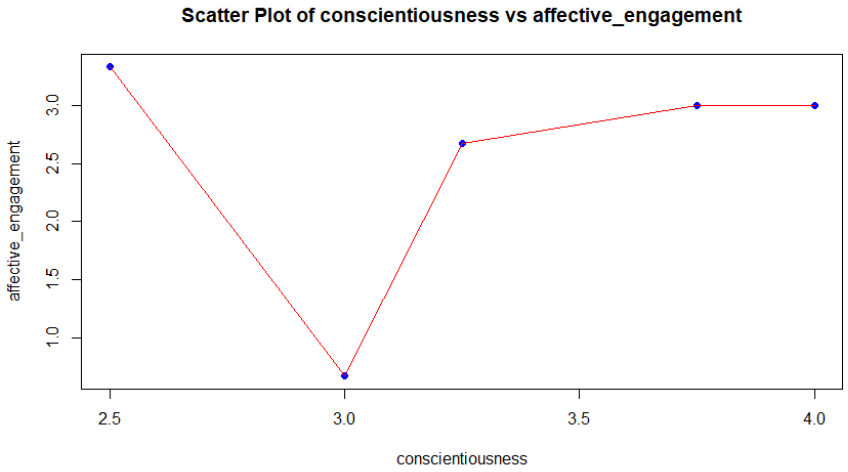
The Relationship of Conscientiousness and Cognitive Engagement



Note. No monotonic relationship.

Figure D8

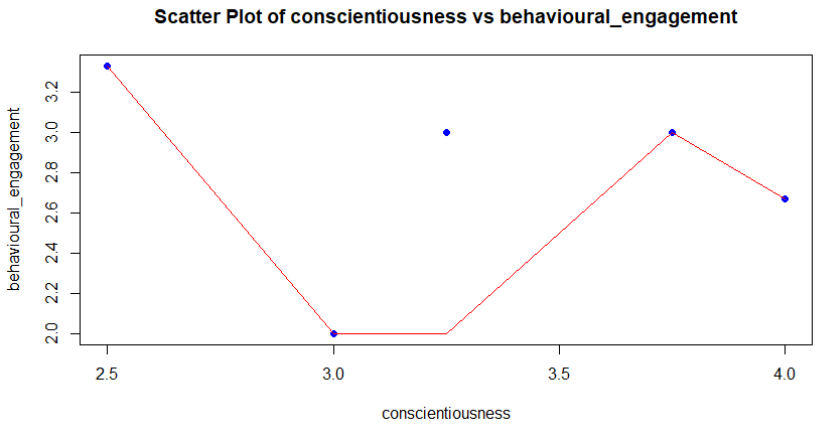
The Relationship of Conscientiousness and Affective Engagement



Note. No monotonic relationship.

Figure D9

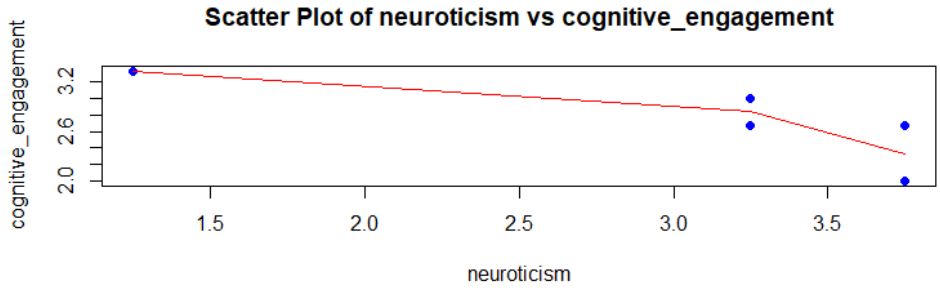
The Relationship of Conscientiousness and Behavioural Engagement



Note. No monotonic relationship.

Figure D10

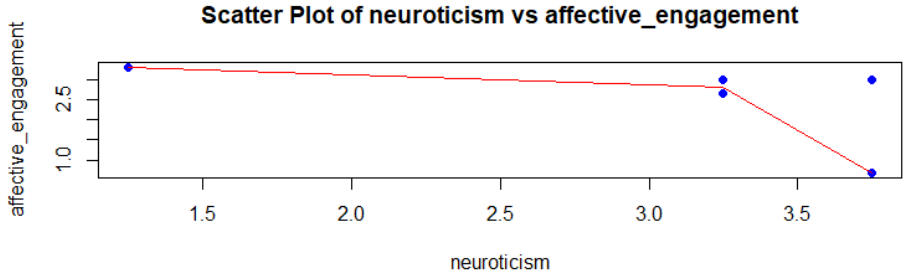
The Relationship of Neuroticism and Cognitive Engagement



Note. A monotonic negative relationship.

Figure D11

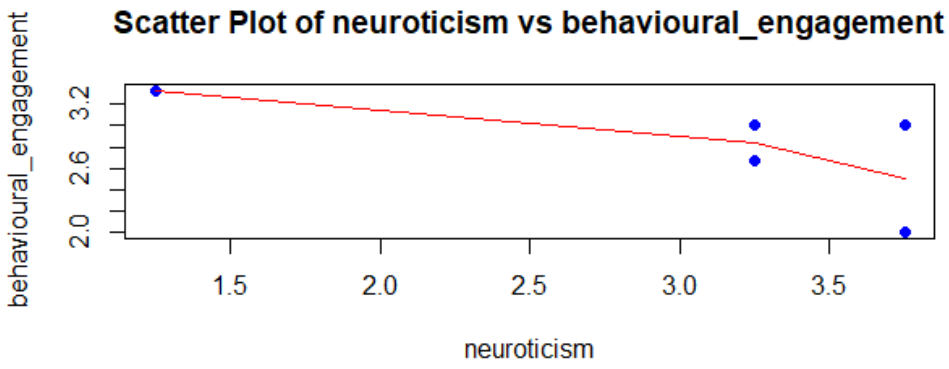
The Relationship of Neuroticism and Affective Engagement



Note. A monotonic negative relationship.

Figure D12

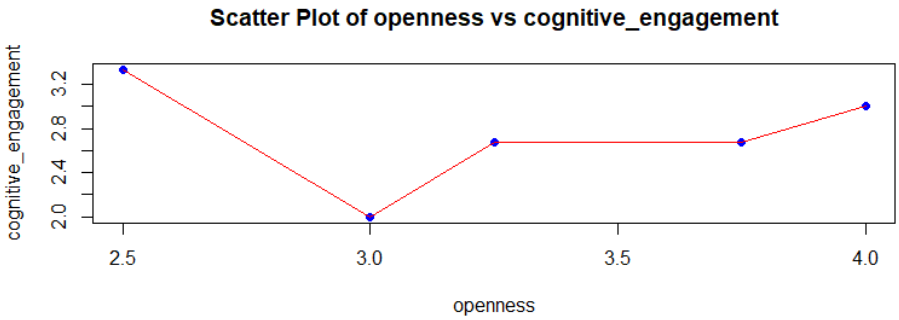
The Relationship of Neuroticism and Behavioural Engagement



Note. A monotonic negative relationship.

Figure D13

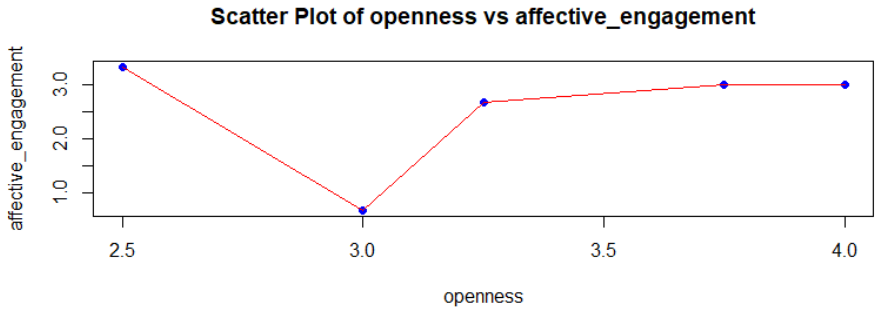
The Relationship of Openness and Cognitive Engagement



Note. No monotonic relationship.

Figure D14

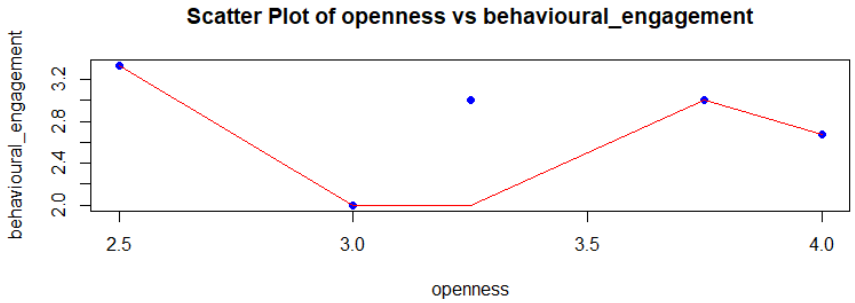
The Relationship of Openness and Affective Engagement



Note. No monotonic relationship.

Figure D15

The Relationship of Openness and Behavioural Engagement



Note. No monotonic relationship.