Compassionate Technology - Illusion or Opportunity?

Development and Validation of a New Scale to Measure Compassion in Technology

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Abstract

Compassion has beneficial effects in the treatment of (mental) healthcare when applied by therapists or physicians in general. Additionally, an increase in digital healthcare solutions has seen a rapid increase in recent years offering technological treatment options to a broader range of patients. It seems therefore logical that technology in order to be effective should incorporate compassionate elements to ensure sufficient treatment. This study aimed to conceptualize, develop, and validate a new measurement to assess the perceived level of compassion in technology. The resulted measurement has 25 items across five dimensions derived from Strauss et al.'s (2016) definition of compassion. Data was collected through a vignette based study (N=69) using three scenarios of different compassionate technologies. Exploratory factor analysis showed that there were indeed five underlying factors present, which could be linked to their conceptualized construct. Four items were removed due to having no factor loadings > 0.6 on any factor. Reliability was excellent with Cronbach's a = 0.93. The results indicate a successful and promising development of measurement for compassion in technology that could have useful applications (e.g. in the design and implementation of healthcare technology).

Keywords: compassion, technology, scale development, factor analysis, validation

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Development of a New Scale to Measure Compassion in Technology

Compassion is an essential construct of (mental) healthcare. It is consistently argued that compassion has positive effects and benefits in direct treatment and recovery of individual suffering (Sinclair et al., 2016; Fotaki, 2015; Lloyd & Carson, 2011). With increasing development of technological treatment options in (mental) healthcare as well as usage over the past years, its environment is becoming less and less dependent on direct human interaction (Materia et al., 2020). Considering this rapid development of health technology and beneficial effects of compassion in healthcare it would appear logical that technology should incorporate compassionate facets. In order to test whether technology can be perceived as compassionate throughout different facets a new scale will be constructed with the aim of validating it on a random sample consisting mostly of university students.

What is Compassion?

An important factor in the further process is to provide a clear understanding of what is meant by 'compassion'. The general consensus on compassion is that it involves the recognition of suffering in another human being and experiencing motivation to help that person (Sinclair et al., 2016; Strauss et al., 2016; de Zulueta, 2013). Noteworthy is that compassion it not only about feeling, such as is the case for the related constructs of empathy and sympathy, but also about acting to relieve suffering. A further distinction is that compassion is specifically related to suffering, whereas sympathy and empathy can be linked to any emotion (such as happiness) (Strauss et al., 2016).

A comprehensive synthesis of earlier definitions of compassion stems from Strauss et al. (2016), who conducted a review of definitions and measures regarding compassion. The researchers reviewed eight preliminary papers defining compassion and derived an overarching construct definition which can potentially be viewed as a five step process of compassion. These five steps or elements are: *1. recognizing suffering, 2. understanding the*

universality of suffering in human experience, 3. feeling for the suffering person (emotional resonance), 4. tolerating uncomfortable feelings aroused in response to the suffering person, 5. motivation to alleviate suffering in the person (Strauss et al., 2016). Further, these elements were considered to be a cognitive, affective, and behavioral process, indicating a conceptual range across multiple human dimensions. This is important because it highlights different angles which should be considered when constructing compassionate interventions, or technology for that matter. Therefore, the following parts will use the aforementioned concept as a basic understanding of compassion.

Why is Compassion Important?

Taking into account that compassion addresses a broad spectrum of human dimensions and is linked to alleviating suffering, it is unsurprising that compassion is used in healthcare. Providing compassionate care appears to increase the general quality level of care given to individuals in need. This is due to an enhanced therapeutic alliance between patient and caregiver (Kemp et al., 2020). The presence of compassion stimulates the patient to be more receptive towards caregivers, which in turn increases the caregivers understanding for and of the patient. Additionally, making use of compassionate interventions supports patient-centered care (Pfaff & Markaki, 2017). Patient-centered care involves viewing the patient as an individual human being with personal needs, own terms and social environment, which should be the focus of the caring process (Epstein & Street, 2011).

The above findings show that compassion is a crucial part of successful treatment that should be integrated into the development and execution of (mental) health care and interventions.

Advances in Technological Healthcare

The past years have seen a rapid development and implementation of new technologies. Technology is being utilized in almost every aspect of life and (mental) healthcare is no exception. For instance, with advances in virtual reality (VR) it has become

possible to treat anxiety disorders at a broader range of patients with lower cost than in-person therapy (Carl et al., 2019). Specifically, the authors assess the effectiveness of virtual reality exposure therapy (VRET) and found that it is as effective as real life exposure. Further, Garcia-Palacios et al. (2007) found that when presented with a choice, 76% of participants would choose VRET over traditional therapy. These findings suggest that technology has the potential to provide treatment options that compare in effectiveness to traditional therapy settings and additionally may lower the threshold in patients to embrace therapy. Several studies have found reinforcing results, a meta-analysis and systematic review by Königbauer et al. (2017) found that mobile-based interventions are consistently effective in reducing depressive symptoms in diagnosed patients. Additionally, a more recent systematic review and meta-analysis by Lau et al. (2021) found that specifically for perinatal women suffering from depression, anxiety, and/or stress digital interventions show promising results. This further supports the importance of technological therapy by shining light onto patients that in general may not be able to attend face-to-face therapy and are therefore reliant on digital solutions.

Another form of technological therapy are embodied conversational agents. These are autonomous entities that consist of a visual embodiment to interact with the user (Provoost et al., 2017). They are more commonly referred to as chatbots or virtual therapists. Usually interactions take place through a computer, where the user enters text or speech and then receives a tailored response. Bendig et al. (2019) show with their scoping review of the usage of chatbots in mental healthcare that the field presents promising results but is still at the very beginning and has obstacles to overcome concerning ethical as well as legal requirements.

However, these findings show the advancement and possibilities of healthcare technology and, given the prospect of autonomous machines, that it becomes necessary to consider and evaluate how human attributes can be incorporated in technology, as they seem to have beneficial effects in therapy. Indeed Miloff et al. (2020) developed a scale measuring

the alliance between a virtual therapist and patient. Their results show that a good alliance between a virtual therapist and patient is a strong prediction on successful treatment. This is important, because it shows that technologies should have attributes that support the therapeutic relationship and alliance.

The Need for a New Scale

The aforementioned findings indicate that mental healthcare develops towards an increased usage of technology and raise the question which human attributes should be included into technology. Integrating the premise that compassion is an important part of successful therapist-patient interaction, it appears logical that the technology used in mental healthcare should encompass compassionate aspects. This suggests that there is elevated need to assess the presence of compassion in technology.

Regarding the measurement of compassion in general, many scales have been introduced. One such scale is the Santa Clara Brief Compassionate Scale (SCBCS; Hwang et al., 2008). According to Straus et al. (2016) the SCBCS focuses on emotionally connecting to strangers suffering. Additionally, it appears to measure compassionate feelings for others and not received by others. Another scale is the Relational Compassion Scale (RCS; Hacker, 2008). It measures different compassion pathways between people. Subscales include perceived compassion by other, compassion between other people, and compassion towards other people.

Although these scales focus on different aspects of compassion (see also Strauss et al., 2016), none of these scales seem to specifically focus on the five elements of compassion introduced earlier. Additionally, it remains to be explored how technology would perform on each of those five elements and, continuing the notion, whether a technology can be perceived as compassionate by its user. This could be achieved by applying Strauss er al.'s (2016) elements to different technologies. However, there is limited to no research available on how and if technologies try to incorporate the five elements of compassion. Therefore, it is

necessary to develop a new scale assessing the perceived compassion in technology, which would also benefit the future development of mental healthcare technologies and could make the presence of compassion in blended treatment visible.

Objectives

The current study aims to create such a scale following a scale development procedure applied by Nelson et al. (2019) and to validate it on a random sample, following the research question to what extent can a newly developed scale measuring the perceived level of compassion in technology be validated using a random sample consisting mostly of university students? This will be achieved through a vignette based study, where scenarios describe an interaction with different technologies.

Method

Conceptualization

Relying closely on the scale development procedure used by Nelson et al. (2019) to construct a technology embodiment scale, the first step in the process of developing and validating a scale about the perceived compassion in technology was to achieve an understanding of the concept of compassion. Specifically to identify what compassion entails and how it can be applied. For this purpose a short literature scan was conducted. The main search terms across various databases, such as Scopus and Google Scholar, were "compassion", "scale" and "technology". The search focused in on the above mentioned article by Strauss et al. (2016) which synthesizes earlier definitions and scales in a methodological robust way towards compassion as a cognitive, affective, behavioral process encompassing five elements, namely *recognizing Suffering*, *understanding the universality of suffering in human experience*, *feeling for the person suffering*, *tolerating uncomfortable feelings aroused in response to the suffering person*, and *motivation to act to alleviate*

suffering. This definition and conceptualization was deemed sufficient for the purpose of this paper.

Development of the Questionnaire

Initial Draft

The initial draft item construction was an iterative and collaborative process focusing on compassion as a cognitive, emotional, and behavioral process (Strauss et al., 2016). Additionally, items were derived from existing questionnaires measuring compassion and self-compassion. Consulted questionnaires were the Santa Clara Brief Compassion Scale (Hwang et al., 2008) and Compassion Scale (Pommier et al., 2019). Three people were involved in the creation process, working remotely in a shared Google Document and conducting video conferences via Microsoft Teams for discussion purposes. After beginning the item creation it was quickly discussed and decided to further include the five aforementioned elements of compassion (Strauss et. al, 2016) into the development process. This was decided, because it was assumed that a more step-like approach to compassion would be smoother to translate into a scale taking the combination of technology with an abstract concept (compassion) into account. Focus therefore shifted towards generating items corresponding to each one of the five elements of compassion. Phrasing of the items was under constant reevaluation to ensure easy comprehension and overall similarity throughout the questionnaire. Further, it was considered that every element should possess around the same number of items. A final first draft resulted in 33 items total divided into six or seven per element (Appendix A).

Expert Evaluation

The final first draft was then given to an expert evaluation team consisting of five researchers from the University of Twente (Netherlands) having a doctorate or working as PhD, with three experts having a background in psychology and two in engineering and design. They were given a shared MS Office document to ensure discussion between

members. In the given draft the experts could see which items belong to which element. Individual experts were able to comment on the document and respond to each other's comments. Afterwards the experts sent an email to the researchers explaining their impressions and feedback in more detail.

Feedback received from the experts resulted in approval of distinguishing the five elements of compassion, but additionally to narrow and improve the foci of the overall questionnaire. It was suggested to steer the questionnaire towards three applications of compassion with regard to technology. Firstly, the support of the technology to foster self-compassion, secondly, the compassionate behavior of the technology itself, and thirdly, the mediating role of technology in compassionate therapy (e.g. blended treatment). Further feedback from the expert team considered item comprehension, as in taking a rephrasing and simplifying approach to make items easier understandable for participants not familiar with compassion research.

Final Questionnaire

With the expert evaluation in mind it was decided to put the foci on compassionate behavior of the technology itself and technology supporting self-compassion. Viewing technology as a mediator in traditional therapy was disregarded for the scope of this paper. The next step was to divide the items into the two categories of self-compassion and technology itself. In the conversion process items were removed due to not fitting with the new concepts or rephrased to address perceived support of technology in self-compassion or ask about compassionate behavior of the technology directly. Further, new items were added which were created by considering the context of the aforementioned two concepts. During the creation process it was decided to have corresponding items in each of the two concepts to increase construct validity between the two (e.g. "*The technology helps me to understand when I am in distress.*" vs. "*The technology understands when I am in distress.*", Appendix B). Additionally items in each concept should be phrased similarly to each other to highlight

the difference between self-compassion and compassionate behavior. Items were still divided into the five elements of compassion, but this distinction was not visible to the respondents. The last step was to rephrase all items to begin in the same manner ("*The technology…*", Appendix B) to embrace the focus on technology. The final questionnaire resulted in 50 items total, divided in 25 items per concept category (self-compassion vs. technology itself), and 8 items for the element recognizing suffering, 8 for understanding universality of suffering, 14 for feeling empathy, 10 for tolerating uncomfortable feelings, and 10 for motivation to act (Appendix B). This paper only focuses on the compassion in technology itself part, for the self-compassion part see Tönjes (2021).

Validation Study

Vignette Based Study

To test the new questionnaire three vignettes were designed, each consisting of a hypothetical scenario describing a different technology acting in a compassionate manner (smartwatch, health app on smartphone, chatbot) (Appendix C). The three technologies were chosen because they differ in their range of possibilities to behave compassionately. The smartwatch is mainly reliant on bodily features, whereas the smartphone app uses data entries from the user as well as physiological features, and finally the chatbot, as a real time communication device, is able to integrate all information received by chatting with the user through AI technology. Further, the scenarios consist of different length to emphasize the possibilities of acting compassionate with regard to their different technological levels and to have some variation in how compassionate they were described to be. Data was collected through a cross-sectional online questionnaire survey design. The questionnaire was administered in English and created using the online software Qualtrics.

Materials

The newly developed questionnaire was used in combination with the designed vignettes. Each vignette had an answer form for all 50 items, divided into two parts (self-

compassion and technology itself). Respondents were given the information to which group the items belonged (Appendix B). Items in each of the two categories (self-compassion and technology itself) were randomized. Additionally, it was randomized whether a respondent would receive items on self-compassion or technology itself first. The scoring system was a 7-point-Likert-Scale, ranging from "strongly disagree" to "strongly agree".

Further, the demographics gender, age, nationality, and education level were asked before the actual survey.

Procedure

Respondents were given information about the background and topic of the study and gave their informed consent beforehand and were informed that it would take approximately 15 minutes to complete. No time limit to fill in the questionnaire was given. At the end of the questionnaire the opportunity to add comments was possible through a textbox (Appendix E).

Participants

Respondents were collected through SONA systems, an online credit system for students who were compensated in form of study credits. Further, respondents came from the personal network of the researchers. The study was approved by the Ethics Committee of the University of Twente, Netherlands.

The vignette study was filled in by 160 participants. After checking for completion and appropriate fill out time of more than 9 minutes (based on the average completion time of the researchers) 69 individual cases remained. Of those 69 were 36 females (52.2%), 32 males (46.4%) and 1 undisclosed (1.4%). The mean age was 24.38 years (St.D.: 6.76, min: 18, max: 66). The majority was German (56.5%), followed by Dutch (18.8%), and various other nationalities (24.6%). Further, most participants either studied at university or had completed it (62.3%).

Data Analysis and Results

In order to test the factor structure and reliability of the questionnaire an exploratory factor analysis (EFA, Principal Component Analysis (PCA) with Promax rotation) and reliability analysis were conducted using the computer software SPSS. PCA with Promax rotation was chosen because Promax does not automatically assume between-factor correlation, rather it begins with orthogonal (varimax) and refines with oblique rotation. It will stay orthogonal if factors are not correlated (Kahn, 2006; Russel, 2002). Before analyzing, the data was aggregated to fit the case data from the three scenarios with 69 respondents each into individual cases, which led to a sample containing 207 responses.

Exploratory Factor Analysis

The preliminary data was then screened for inconsistencies by checking the mean scores and standard deviation of items for normality, as well as for multiple correlations between items above 0.9 for multicollinearity (Appendix D). This did not result in any problematic items and thus none were removed beforehand, but it should be mentioned that items 21, 23 and 24 correlated below 0.3 with other items but acceptable with themselves. It was decided to leave them in the analysis because they form an elemental concept together. Further, it should be noted that the data showed multicollinearity with the correlation determinant being < 0.00001, but according to Field (2018, p. 799) this is not a problem when conducting PCA, and thus no attempts were made to remove multicollinearity.

The first run of PCA was conducted on all 25 items. The Kaiser-Meyer-Olkin criterion (KMO) was 0.93, indicating a marvelous sampling adequacy to perform factor analysis (Kaiser & Rice, 1974, as cited in Field, 2018, p. 798). The anti-image correlations were between 0.65 and 0.95 with a mean of 0.89 and only five items below 0.9. Results showed that five factors were above the threshold of Eigenvalue > 1 (Kaiser's criterion) and explained a combined total of 73.98% of variance. The scree plot only supported three factors after

fitting the point of inflexion (Figure 1). However, it was decided to retain five factors, because Kaiser's criterion was sufficient, and five factors fit with the conceptualization.

Figure 1

Scree Plot
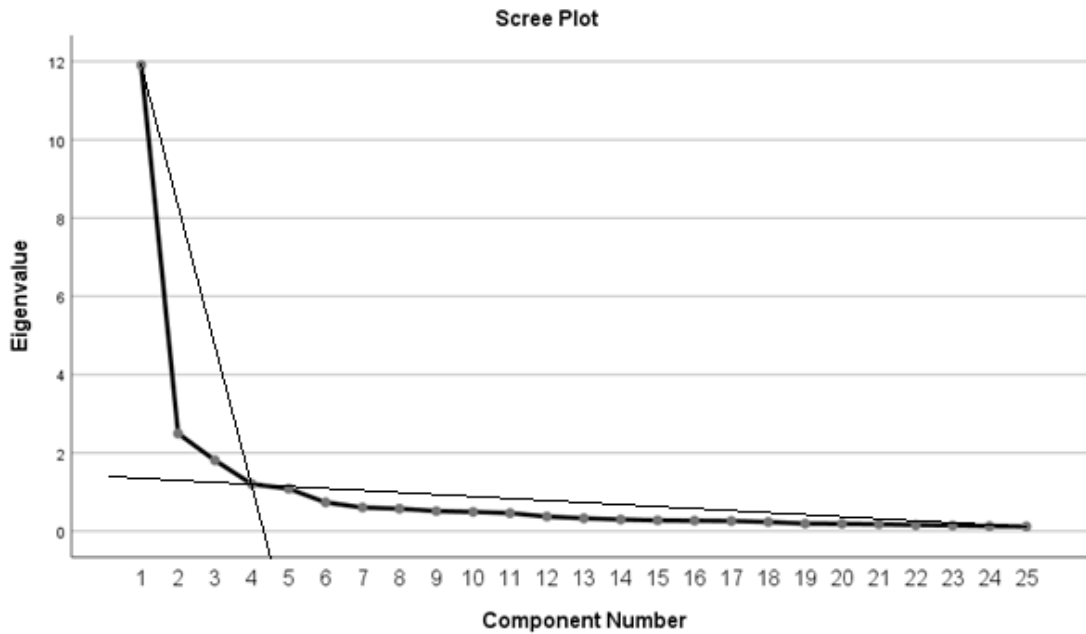
Table 1 shows the resulted pattern matrix. It reveals that items 13, 18, 20 and 25 did not load higher than the threshold of 0.6 on any factor and were therefore removed (Baistaman et al., 2020).

Table 1

Factor Loadings All Items (Pattern Matrix)

	Components				
	1	2	3	4	5
trans11 - The technology cares about my well-being.	**0.95**	-0.11	0.02	-0.08	0.09
trans14 - The technology emotionally connects with myself.	**0.89**	0.09	-0.02	-0.11	-0.09
trans15 - The technology emotionally connects with my distress.	**0.81**	0.04	0.12	-0.10	-0.09

trans22 - The technology takes care of me.	**0.75**	-0.04	0.17	-0.04	0.13
trans10 - The technology is empathetic with my distress.	**0.74**	0.14	0.01	0.00	-0.10
trans12 - The technology has unconditional positive regard for me.	**0.64**	0.00	-0.01	0.15	0.08
trans6 - The technology shows that distress is commonly experienced by all people.	-0.09	**0.98**	0.00	-0.02	-0.03
trans8 - The technology shows that experiencing distress is normal.	-0.10	**0.94**	0.04	0.03	0.01
trans7 - The technology indicates that I am not the only one suffering.	0.10	**0.85**	-0.04	-0.04	-0.12
trans5 - The technology shows that difficulties are part of human life.	0.18	**0.84**	-0.03	-0.04	-0.01
trans9 - The technology welcomes distress as part of me.	0.12	**0.66**	0.09	-0.03	0.13
trans4 - The technology notices when I am not feeling well.	0.01	-0.13	**0.94**	0.06	0.04
trans2 - The technology understands when I am in distress.	-0.07	0.05	**0.86**	0.10	0.01
trans3 - The technology understands when something is wrong.	0.14	-0.03	**0.78**	-0.01	0.02
trans1 - The technology notices when I am going through a difficult time.	0.15	0.19	**0.72**	-0.16	0.03
trans13 - The technology is aware of my emotions and distress.	0.24	0.20	0.59	-0.04	-0.11
trans16 - The technology does not judge me.	-0.07	-0.06	-0.14	**0.96**	-0.09
trans17 - The technology is okay with my distress.	-0.08	-0.09	0.14	**0.93**	-0.09
trans19 - The technology keeps calm in response to my distress.	-0.11	0.19	0.13	**0.67**	0.19
trans18 - The technology accepts when I am having a hard time.	0.44	-0.02	0.15	0.46	-0.14
trans20 - The technology accepts that distress bothers me.	0.19	0.35	0.11	0.35	0.01
trans23 - The technology shows that I can achieve my goal.	-0.02	0.15	-0.21	-0.04	**0.87**
trans24 - The technology shows that I could benefit from changing my usual patterns.	-0.31	0.03	0.35	-0.13	**0.84**
trans21 - The technology sets healthy goals for me.	0.30	-0.36	0.02	0.03	**0.74**
trans25 - The technology supports me.	0.33	0.22	-0.26	0.26	0.42
Eigenvalues	11.91	2.50	1.81	1.20	1.08
% of variance	47.63	9.98	7.24	4.80	4.33

Note. Factor loadings >= 0.6 in bold.

After removal of items 13, 18, 20 and 25 another PCA was conducted on the remaining items. The resulting set of 21 items had a KMO of 0.92, again indicating marvelous sampling adequacy. Bartlett's test of sphericity was 3274 (p < .001), and five factors with Eigenvalue > 1 explaining 75.87% of variance were retained. The factor loadings for the 21 items are shown in Table 2.

Table 2

Factor Loadings 21 Items (Pattern Matrix)

	Components				
	1	2	3	4	5
trans11 - The technology cares about my well-being.	**0.91**	-0.07	0.12	-0.03	0.09
trans14 - The technology emotionally connects with myself.	**0.85**	0.11	-0.02	-0.07	-0.08
trans15 - The technology emotionally connects with my distress.	**0.79**	0.06	0.10	-0.05	-0.09
trans22 - The technology takes care of me.	**0.73**	-0.01	0.15	0.01	0.12
trans10 - The technology is empathetic with my distress.	**0.72**	0.14	0.02	0.05	-0.11
trans12 - The technology has unconditional positive regard for me.	**0.66**	0.00	-0.03	0.21	0.07
trans6 - The technology shows that distress is commonly experienced by all people.	-0.06	**0.95**	-0.02	0.01	-0.01
trans8 - The technology shows that experiencing distress is normal.	-0.08	**0.93**	0.04	0.04	0.03
trans7 - The technology indicates that I am not the only one suffering.	0.12	**0.85**	-0.06	-0.01	-0.09
trans5 - The technology shows that difficulties are part of human life.	0.19	**0.83**	-0.04	-0.01	0.02
trans9 - The technology welcomes distress as part of me.	0.13	**0.63**	0.11	-0.02	0.12
trans4 - The technology notices when I am not feeling well.	0.04	-0.13	**0.94**	0.05	-0.01
trans2 - The technology understands when I am in distress.	-0.04	0.04	**0.88**	0.09	-0.05

trans3 - The technology understands when something is wrong.	0.14	-0.01	**0.80**	-0.04	-0.01
trans1 - The technology notices when I am going through a difficult time.	0.13	0.18	**0.74**	-0.17	-0.01
trans16 - The technology does not judge me.	0.02	-0.02	-0.16	**0.92**	-0.07
trans17 - The technology is okay with my distress.	0.01	-0.03	0.12	**0.87**	-0.08
trans19 - The technology keeps calm in response to my distress.	-0.06	0.21	0.16	**0.63**	0.18
trans23 - The technology shows that I can achieve my goal.	-0.03	0.19	-0.24	-0.04	**0.89**
trans24 - The technology shows that I could benefit from changing my usual patterns.	-0.24	0.03	0.27	-0.07	**0.82**
trans21 - The technology sets healthy goals for me.	0.31	-0.28	-0.07	0.04	**0.77**
Eigenvalues	9.76	2.37	1.64	1.15	1.02
% of variance	46.46	11.27	7.80	5.48	4.86

Note. Factor loadings >= 0.6 in bold.

The results show a clear factor structure for the developed compassionate technology scale. Five factors can be derived from the analysis, indicating that the conceptualized elements are indeed visible in the data. Comparing the factor items with the scale items (Table 3) divided into the five elements of compassion (Strauss et al., 2016) each factor item matches its conceptualized element except for two.

The first, Item9 ("The technology welcomes distress as part of me.") was thought to belong to the element of *feeling empathy for the person suffering*, but factor analysis indicated that it belongs to the factor *understanding the universality in human suffering*. It does not load significantly high on any other factor.

The second item that loaded differently than expected is Item22 ("The technology takes care of me."), which was thought to belong to the element of *motivation to act/acting to alleviate suffering*, yet results show that it is closer related to the element *feeling empathy for the person suffering*. Comparing its factor loadings it can be said that it does not significantly belong to any other element than feeling empathy by any standard.

Table 3

Scale Items in Relation to Factors

Scale Item	Factor
Recognizing Suffering	
Item1 - The technology notices when I am going through a difficult time.	3
Item2 - The technology understands when I am in distress.	3
Item3 - The technology understands when something is wrong.	3
Item4 - The technology notices when I am not feeling well.	3
Understanding the Universality in Human Suffering	
Item5 - The technology shows that difficulties are part of human life.	2
Item6 - The technology shows that distress is commonly experienced by all people.	2
Item7 - The technology indicates that I am not the only one suffering.	2
Item8 - The technology shows that experiencing distress is normal.	2
Feeling Empathy for the Person Suffering	
Item9 - The technology welcomes distress as part of me.	2
Item10 - The technology is empathetic with my distress.	1
Item11 - The technology cares about my well-being.	1
Item12 - The technology has unconditional positive regard for me.	1
Item13 - The technology is aware of my emotions and distress.	Eliminated
Item14 - The technology emotionally connects with myself.	1
Item15 - The technology emotionally connects with my distress.	1
Tolerating Uncomfortable Feelings	
Item16 - The technology does not judge me.	4
Item17 - The technology is okay with my distress.	4
Item18 - The technology accepts when I am having a hard time.	Eliminated
Item19 - The technology keeps calm in response to my distress.	4
Item20 - The technology accepts that distress bothers me.	Eliminated
Motivation to Act/Acting to Alleviate Suffering	
Item21 - The technology sets healthy goals for me.	5
Item22 - The technology takes care of me.	1
Item23 - The technology shows that I can achieve my goal.	5
Item24 - The technology shows that I could benefit from changing my usual patterns.	5
Item25 - The technology supports me.	Eliminated

Note. Factor 1: Feeling Empathy for the Person Suffering, Factor 2: Understanding the Universality in Human Suffering, Factor 3: Recognizing Suffering, Factor 4: Tolerating Uncomfortable Feelings, Factor 5: Motivation to Act/Acting to Alleviate Suffering.

Reliability Analysis

The reliability analysis was conducted on the resulting 21 items from the factor analysis. The overall reliability was excellent with Cronbach's a = 0.93. The first set of items (factor 1) had an excellent reliability of Cronbach's a = 0.91. The second set (factor 2) had an excellent reliability of a = 0.93. The third set of items (factor 3) had an excellent reliability of a = 0.91. The fourth set (factor 4) had a good reliability of a = 0.81. And the fifth and final set of items (factor 5) had an acceptable reliability of a = 0.77.

Discussion

The findings of this study show that the proposed scale has an underlying factor structure which is almost completely in alignment with its theoretical conceptualization. Five factors can clearly be identified by their respective items and can be summarized in order of size into *feeling empathy, understanding universality of suffering, recognizing suffering, tolerating uncomfortable feelings* and *motivation to act*. These are in accordance with Strauss et al.'s (2016) five elements of compassion used in the development process. This suggests that the scale indeed measures five elements of compassion and is a good conceptual fit to the aforementioned literature.

The New Scale

Although most of the items in the new scale match their conceptualized counterpart, there are two items that belong to a different compassionate element. The first, Item9 ("The technology welcomes distress as part of me.") turned out to fit better with the element *understanding the universality in human suffering* and when taking a look at the item phrasing this makes sense. The word "welcomes" suggests an understanding approach as in understanding and accepting that suffering is part of being human. Additionally, when compared to the items belonging to feeling empathy, Item9 is the only one that cannot be directly related to emotional resonance in contrast to for example Item10 "The technology is

empathetic with my distress.". "Empathetic" clearly references an emotional resonance which may also be apparent to the participant. "Welcomes distress" would be more open towards interpretation when trying to read emotional resonance into it, because resonance usually references an imaginative condition of a certain state in another person (Cameron et al., 2013). Therefore, it is acknowledged that Item9 belongs to a different element than conceptualized.

The second item, Item22 ("The technology takes care of me."), turned out to belong to the element *feeling empathy for the person suffering*. This is a surprising find, because "taking care" would generally be considered an act of behavior rather than emotional resonance (McCullough et al., 2016). A possible explanation as to why it loads differently than assumed could stem from looking at the other factor items. Items that fall under motivation to act/acting are quite specific in their phrasing, e.g. Item24 "The technology shows that I could benefit from changing my usual patterns.", whereas items falling under feeling empathy are generally broader in their meaning, e.g. Item11 "The technology cares about my well-being.". Further, the items for motivation to act/acting are related to goal setting and changing one's way. This suggest an underlying conceptual difference between caretaking on the one hand and goal setting on the other.

Additionally, in terms of technology, taking care may be perceived by humans as understanding human emotions and perspective. This is known as cognitive empathy (Strauss et al., 2016) and therefore would present a reason as to why the item loads on feeling empathy for the person suffering. Further, as for humans it may mean to devote one's entire life, including accepting loss in personal activities, to take care of a suffering individual (Melamed & Gelkopf, 2013) and perform caretaking activities such as showering. This devotion would imply a voluntary choice made by the caregiver, which the suffering person may pick up on and associate with caretaking. This subtle difference could be the reason as to why caretaking may be interpreted differently in humans and technologies.

Shifting focus towards the factor motivation to act/acting to alleviate suffering. The according items (21, 23, 24) are, as mentioned above, related to goal setting and changing behavior. Additionally, its low Eigenvalue and acceptable reliability suggest that it should be used with caution. This and their unsignificant correlation with the other items (a < 0.3, Field, 2018) may raise the question as to whether this factor actually represents the element of motivation to act/acting to alleviate suffering in a sufficient manner. Rather it appears that it simply represents the notion of goal setting with the help of technology (Consolvo et al., 2009). The item's phrasing may also be more interpreted in an active way which is not necessarily related to suffering or compassion (e.g. sport). This could have led to different understanding of the items by participants and therefore have led to a different factor than conceptualized.

Implications

There are two implications that can be derived from this study. Firstly, this was a first attempt at the development of a scale that assesses the perceived compassion in technology. It could be the foundation for future scale development in compassionate technology. The scale showed that it is possible to quantify the abstract concept of compassion in a clearly structured manner while being able to retain a theoretical scaffold. This could further lead to a better understanding of the importance of compassion in general and raise the overall awareness of the subject (see Kemp et al., 2020).

Secondly, it could be applied in the development of mental healthcare technologies as a feedback measurement of compassion in technology. This is important, because various research has shown the benefits of compassion, as well as of using technology in therapy (Carl et al., 2019; Miloff et al. 2020; Provoost et al., 2017). Developing digital solutions for mental healthcare may also lower the overall cost and therefore may be accessible to a broader range of people (Carl et al., 2019). Additionally, it is important to assess already in practice technology and gain more insights into the workings of it. Being able to assess

whether a technology is perceived as compassionate may also be an important factor to evaluate the success of such technologies (Strudwick et al., 2019). For instance if a technology does not proof to be effective, measuring its compassion may give an indication on what could be improved to establish success.

Comparison With Self-Compassion Study

The current questionnaire was part of a two-part questionnaire on compassionate technology. The second part focusses on the perceived support for self-compassion in technology (Tönjes, 2021). The items in both parts were similarly phrased in only differed in regard to self-compassion and compassion in technology (e.g. "*The technology emotionally connects with me.*" vs. "*The technology helps me to emotionally connect with myself.*", Appendix B). Therefore, it may be interesting to compare the two outcomes in regard of item elimination, factor structure and reliability (Table 4).

Table 4

Scale Comparison

	Technology Scale	Self-Compassion Scale
Factors found	5	3
Variance explained	75.87%	72.97%
Reliability [a]	0.93	0.96
Items eliminated	13,18, 20, 25	12, 13, 14, 20, 25

a) Cronbach's alpha

Both studies failed to assign items 13, 20, 25 to a specific factor, the current study on compassion in technology further eliminated Item18, and the self-compassion study eliminated items 12 and 14 additionally. Items 12 and 14 regard having unconditional positive regard for and emotionally connecting with oneself. A possible explanation why there is a

difference in eliminated items might be that unconditional positive regard and emotional connecting are more difficult to comprehend in regard to oneself and are easier perceived when received from a third party. Interestingly, research found that self-compassion can increase unconditional positive regard towards others (Tiwari et al., 2020). This raises the question whether a different outcome would have been achieved with the item being phrased towards others instead of oneself.

Further noteworthy is that the current compassionate technology scale retained five factors whereas the self-compassion scale only three. Indeed Neff (2003) conceptualized self-compassion consisting of three components. There are *extending kindness and understanding to oneself*, *seeing one's experience as part of the larger human experience*, and *holding one's thoughts and feelings in balanced awareness*. These seem to correspond to some extent to Strauss et al.'s (2016) five elements. It would be interesting to explore whether these three components are visible in the self-compassion scale (Tönjes, 2021). Further, the reason for three factors instead of five could be that the perceived distinction between the five elements of compassion is clearer visible in technology than in oneself. Meaning that elements merge together when felt in oneself compared to perceived from a third party. This would further be interesting to explore in future research whether the five elements are perceived differently in oneself than in others. Otherwise, the two scales are similar in regard to their explained variance and reliability.

Limitations

There were several limitations to this study. Firstly, the results are based on a vignette study with written scenarios. Although this has the advantage that it can be specifically related to the research topic and give participants the same general idea of the technology (Atzmüller & Steiner, 2010; Nelson et al., 2019), vignettes or scenarios do not compensate for a "hands on" experience of technology. This could influence the outcome, because it could be difficult for people to imagine technologies acting in a human manner. Comments from participants

support this claim, as one commented "[…] *this questionnaire makes it seem like you think you can fix human problems with technology. Don't you realize that it is really really bad if you feel lonely and stressed, and instead of having friends you need talk a piece of technology*" or "[…] *technology do*[es] *not have the capacity to understand those hard matters as feeling and emotions.*" (Appendix E). Further, in this specific study participants were asked to imagine a scenario with mental health issues (e.g. depression), which is not an easy task and when never having experienced an actual mental disorder, it can be nearly impossible to fully imagine.

Secondly, the questionnaire in combination with its counterpart on self-compassion (Tönjes, 2021) was rather long and repetitive, especially when considering that respondents had to answer each question three times (once for each scenario). As some participants commented "[*p*]*retty long and repetitive.*" or "[*t*]he *question were pretty similar and long.*" (Appendix E). This may have induced response fatigue in participants, which could result in inaccurate answering (Choi & Pak, 2005). A solution to this would be to administer the questionnaire on only one technology or separate it from its counterpart on self-compassion (Tönjes, 2021).

Future Research and Recommendations

Recommendations for future research are based on the limitations and general thoughts of the author. Firstly, the questionnaire should be tested further on different samples to test reliability. Additionally, it is recommended to apply a CFA to the questionnaire. This would increase validity, test for convergent and discriminate validity, and confirm the underlying, hypothetical construct made visible through EFA (Hee-Ju, 2008).

Secondly, it might be interesting to explore how this questionnaire holds for different scenarios. This would test whether results can be replicated using different technologies. Building on this, applying this questionnaire to "hands-on" technologies (e.g. prototypes or finished products) would be beneficial in assessment of its usefulness (Xu et al., 2007). This

could also mean applying this questionnaire to a specific target group, who have used actual technology to cope with mental distress.

Thirdly, building on the last point, it could be beneficial to involve clients and therapists and the further construction and application of the scale. Due to timely constraints it was not possible to gain insight from people that are actually involved in the usage of technologies. Having their knowledge and experience involved could benefit a possible future refinement (Bendig et al., 2019). This could be by assessing specific compassionate needs in patients and see to which of Strauss et al.'s (2016) elements these needs correspond to in order to focus more on one element over another.

Fourthly, the scale is rather long and was also perceived that way (see comments from participants, Appendix E). Future research could aim at reducing the number of item in the scale towards a possible short version of it. This would also be beneficial when evaluating technologies that target clients who do not possess the cognitive ability to focus or concentrate for longer periods of time (Marazziti et al., 2010).

Fifthly, future research should examine the fifth factor under the assumption that it is not actually the conceptualized construct of motivation to act but rather goal setting. If items were refined to have a better conceptual fit with the element, the factor might be a more fitting match for the whole construct. Possible significant correlations with other items, not achieved in the current study, would ensure construct validity, and improve the overall scale.

Finally, it would be interesting to see how this scale compares to other measurements assessing compassion in technology. Therefore, it is encouraged to dive into the development of new scales, because it can have real life benefits and help engineer mental health technologies that assist people in need. The current research has attempted a first step towards a newly developing field of research concerning the development and integration of compassion into technologies to broaden the extent to which mental healthcare is available to a larger number of people.

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Appendix A

First draft questionnaire

Compassionate technology scale - Draft

Recognizing suffering
1. When using the technology, it makes me feel understood in my experience.
2. I have the feeling that the technology senses when I am going through a difficult time.
3. I feel like the technology recognizes my distress, even if I am not actively consulting it.
4. The technology helps me to understand that I would profit from comfort and help.
5. I have the feeling the technology does not notice my distress. [reversed item]
6. The technology can identify when I am in need for support.

Understanding the universality of suffering in human experience
7. The technology acknowledges that my struggling is part of human life.
OR Using the technology helps me to acknowledge that my struggling is part of human life.
8. Using the technology helps me to keep a balanced view of a difficult situation.
9. The technology helps me to gain the perspective that feeling unmotivated and tired is commonly experienced by all people.
10. The technology helps me to see that my imperfections are part of being human.
11. The technology helps me to look at the bigger picture of my situation.
12. The technology helps me to see that hard times are part of life.
13. The technology shows me that I am not the only one who struggles sometimes.

Feeling empathy for the person suffering and connecting with the distress (emotional resonance)
14. The technology shows empathy towards my concerns.
15. I feel like the technology is attuned to my feelings.
16. The technology heightens my understanding/ acceptance of my own distress.
17. The technology gives me the feeling of attunement towards my daily hassles.
18. The technology is sensitive towards my well-being.
19. I have the feeling the technology cannot attune to my feelings. [reversed item]
20. I do not feel connected to the technology. [reversed item]

Tolerating uncomfortable feelings aroused in response to the suffering person (e.g. distress, anger, fear) so remaining open to and accepting of the person suffering
21. When interacting with/using the technology, I feel that I am being accepted in my thoughts and feelings.
22. The technology gives me the feeling of being open to my flaws and inadequacies.
23. The technology helps me to see my distress as natural.
24. The technology helps me keep a balanced view of my situation.
25. Using the technology helps me understand that it is okay that I am going through a difficult time.
26. I have the feeling that the technology is judging/ evaluating my distress negatively. [reversed item]

Motivation to act/acting to alleviate suffering
27. I have the feeling that the technology is responsive to my needs.
OR using technology makes me more responsive to my own needs.
28. The technology helps me to see that my experience is valid and worthy of help.
29. The technology's intention to help me is based on its understanding of my feelings.
30. Using the technology makes me feel cared for.
31. I do not feel like the technology is tailored to my needs. [reversed item]
32. The technology helps me to see my strengths and possibilities.
33. I feel like the technology is unconditionally there for me.

Appendix B

Final questionnaire

Here you can answer questions about the role of technology in forming self-compassion!
1. The technology helps me to notice when I am going through a difficult time.
2. The technology helps me to understand when I am in distress.
3. The technology helps me to notice when I am not feeling well.
4. The technology helps me to understand when something is wrong.
5. The technology helps me to understand that difficulties are part of human life.
6. The technology helps me to see that distress is commonly experienced by all people.
7. The technology helps me to understand that I am not the only one suffering.
8. The technology helps me to understand that experiencing distress is normal.
9. The technology helps me to welcome distress as a part of me.
10. The technology helps me to be empathetic with my distress.
11. The technology helps me to care for my well-being.
12. The technology helps me to have unconditional positive regard for myself.
13. The technology helps me to be aware of my emotions and distress.
14. The technology helps me to emotionally connect with myself.
15. The technology helps me to emotionally connect with my distress.
16. The technology helps me not to judge myself.
17. The technology helps me to be okay with my distress.
18. The technology helps me to accept when I am having a hard time.
19. The technology helps me to keep calm in response to my distress.
20. The technology helps me to accept that distress bothers me.
21. The technology helps me to set healthy goals for myself.
22. The technology helps me to take care of myself.
23. The technology helps me to see that I can achieve my goal.
24. The technology helps me to understand that I could benefit from changing my usual patterns.
25. Technology helps me to feel supported.

Here you can answer questions about the technology itself!
1. The technology notices when I am going through a difficult time.
2. The technology understands when I am in distress.
3. The technology understands when something is wrong.
4. The technology notices when I am not feeling well.
5. The technology shows that difficulties are part of human life.
6. The technology shows that distress is commonly experienced by all people.
7. The technology indicates that I am not the only one suffering.
8. The technology shows that experiencing distress is normal.
9. The technology welcomes distress as part of me.
10. The technology is empathetic with my distress
11. The technology cares about my well-being.
12. The technology has unconditional positive regard for me.
13. The technology is aware of my emotions and distress.
14. The technology emotionally connects with me.
15. The technology emotionally connects with my distress.
16. The technology does not judge me.
17. The technology is okay with my distress.
18. The technology accepts when I am having a hard time.
19. The technology keeps calm in response to my distress.
20. The technology accepts that distress bothers me.
21. The technology sets healthy goals for me.
22. The technology takes care of me.
23. The technology shows that I can achieve my goal.

24. The technology shows that I could benefit from changing my usual patterns.
25. The technology supports me.

Appendix C

Vignette scenarios

Vignette 1:

Please imagine you have been using a smartwatch to track your daily activity. The smartwatch tracks your daily activity in order to provide you with insights on your health and well-being. It tracks your daily movement in steps, hours of sleep each night, and calorie burn. It displays your activity and sleep patterns via scores and figures on your wrist. It also compares your daily activity to your personal activity goals. Therefore, it knows when you did a workout and how intense it was for you personally. Please imagine the following happening:
You are wearing a smartwatch on your wrist. You are working out three days a week for one hour to achieve your weekly goal. You just finished your workout, and you receive the following message on the screen: "You have been working hard today to achieve your weekly goal! Good job and keep it moving."

Vignette 2:

Please imagine you have been using a health app on your phone to track your daily activity. The smartwatch tracks your daily activity in order to provide you with insights on your health and well-being. It tracks your daily movement in steps, hours of sleep each night, and calorie burn. It displays your activity and sleep patterns via scores and figures on your wrist. It also compares your daily activity to your personal activity goals. Therefore, it can measure the steps you have taken in a day and compare them with other days or weeks. You can also write down your experience in a form of a diary or a feedback entry.
You have the health app on your phone for four months now. At first you did not use it very often but now you got used to it and you have a look at it once or twice a day.

Please imagine the following happening:
It is short after lunchtime and you are feeling very low in energy and your body shows several signs of stress like tension in your muscles and a headache. This is because you are having an important exam tomorrow and you are normally not so good with exam stress and relaxing yourself like taking a break or meditating. Out of a habit you check your health app and see that you almost did not take any steps today. The health app gives you a hint with a message saying: "Take some time to move your body and relax your muscles, you can better concentrate when you have taken a walk". Afterwards, it suggests that taking a break is important when having a stressful time and that a relaxation video could help. It shows some videos with very professional and experienced therapists explaining the advantages of breathing and relaxation exercises specifically tailored to your tensions which are caused by stress. After you have watched a video and participated in the exercises you are asked how you feel and how you experienced the break.

Vignette 3:

Please imagine you have been using a chatbot to talk about your mental health. A chatbot is a fictional person in your web browser, with whom you can communicate. It can give you tailored answers to your questions and can give you the feeling like you are talking to someone, who actually feels and thus, is able to motivate you and to show compassion. Through the information given by you, it can learn about your characteristics and habits and therefore make conversations private and intimate. You normally approach the chatbot every two days for two months now in order to adhere to your mental health program. You feel quite comfortable with talking with it already.

Please imagine the following happening:
You have had a stressful day and night. You feel like you could not sleep at all and as if you cannot get any work done. You tell the chatbot that you are feeling worthless with all the tension on your

shoulders and not being able to deliver the performance others and you are expecting you to. The chatbot answers through showing the following message on the screen: "Do you know that everybody has bad days sometimes? That is normal. If you did not get enough sleep because of the stressful day, everybody would be tired and unproductive. Don't worry!"

Appendix D

Correlation Matrix

Correlation Matrix[a]

Correlation	Item1	Item2	Item3	Item4	Item5	Item6	Item7	Item8	Item9	Item10	Item11	Item12	Item13	Item14	Item15	Item16	Item17	Item18	Item19	Item20	Item21	Item22	Item23	Item24	Item25
Item1 - The technology notices when I am going through a difficult time.	.																								
Item2 - The technology understands when I am in distress.	.73	.																							
Item3 - The technology understands when something is wrong.	.68	.72	.																						
Item4 - The technology notices when I am not feeling well.	.75	.75	.72	.																					
Item5 - The technology shows that difficulties are part of human life.	.60	.54	.54	.47	.																				
Item6 - The technology shows that distress is commonly experienced by all people.	.52	.49	.49	.42	.81	.																			
Item7 - The technology indicates that I am not the only one suffering.	.50	.49	.47	.40	.80	.76	.																		
Item8 - The technology shows that experiencing distress is normal.	.58	.53	.49	.45	.82	.81	.77	.																	
Item9 - The technology welcomes distress as part of me.	.58	.52	.49	.50	.68	.58	.58	.67	.																
Item10 - The technology is empathetic with my distress.	.56	.53	.52	.56	.63	.52	.52	.54	.53	.															
Item11 - The technology cares about my well-being.	.54	.50	.55	.53	.56	.45	.46	.52	.46	.64	.														
Item12 - The technology has unconditional positive regard for me.	.44	.49	.43	.48	.49	.40	.49	.44	.52	.55	.60	.													
Item13 - The technology is aware of my emotions and distress.	.75	.71	.70	.75	.67	.61	.57	.51	.57	.59	.57	.48	.												
Item14 - The technology emotionally connects with myself.	.59	.48	.52	.47	.60	.51	.52	.51	.53	.67	.65	.54	.65	.											
Item15 - The technology emotionally connects with my distress.	.56	.53	.60	.54	.59	.50	.53	.49	.59	.62	.58	.65	.65	.79	.										
Item16 - The technology does not judge me.	.14	.20	.14	.20	.32	.32	.25	.33	.29	.22	.24	.34	.20	.21	.21	.									
Item17 - The technology is okay with my distress.	.27	.42	.36	.35	.42	.41	.41	.45	.34	.42	.30	.41	.40	.34	.35	.58	.								
Item18 - The technology accepts when I am having a hard time.	.56	.52	.57	.51	.60	.49	.54	.57	.51	.57	.60	.49	.63	.61	.38	.43	.57	.							
Item19 - The technology keeps calm in response to my distress.	.39	.50	.42	.45	.54	.46	.43	.52	.46	.42	.39	.40	.39	.51	.43	.57	.58	.62	.						
Item20 - The technology accepts that distress bothers me.	.57	.54	.53	.51	.65	.60	.59	.61	.67	.56	.50	.50	.60	.55	.39	.35	.67	.72	.62	.					
Item21 - The technology sets healthy goals for me.	.12	.08	.17	.15	-.02	-.12	-.08	-.07	.04	.06	.29	.20	.02	.11	.14	.08	.17	.14	.23	.11	.				
Item22 - The technology takes care of me.	.61	.55	.57	.58	.60	.44	.47	.52	.50	.62	.80	.57	.61	.61	.62	.27	.36	.57	.46	.55	.53	.			
Item23 - The technology shows that I can achieve my goal.	.03	.07	.07	.09	.01	.00	-.09	.01	.10	.01	.17	.17	-.01	.06	.08	.06	.03	.07	.09	-.04	.22	.13	.		
Item24 - The technology shows that I could benefit from changing my usual patterns.	.17	.20	.19	.23	.02	.01	-.08	.02	.14	.03	.11	.16	.17	.02	.06	.00	.10	.09	.22	.13	.53	.21	.47	.	
Item25 - The technology supports me.	.33	.30	.31	.29	.39	.31	.26	.39	.41	.39	.44	.40	.37	.41	.33	.39	.46	.54	.48	.29	.57	.44	.44	.21	.

Appendix E

Participants comments on the questionnaire

Q15 - If you have any final remarks or comments about the questionnaire, please feel free to fill them in below! Otherwise click on the arrow below to finish the questionnaire and record your responses!

"I think it was difficult to understand what you mean by feeling and emotions regarding technology. Because technology do not have the capacity to understand those hard matters as feeling and emotions."

"I would not get into the scenarios exposed in part two and three. I just use the technology as fun. I won't take it as serious advice!"

"It is never the technology that sets my goals or cares about my well-being. It is always me, who sets my goals. I just let the technology and it's algorithm somehow know about my mental or physical conditions. The technology is only able to track deviations in its collected data about me and was programmed to "react" in a certain way. But that is nothing the technology does on its own. Behind that were humans, programming the different types of technology to "behave" in a certain way to fullfill their specific task on supporting my health in a certain way.
I am aware of that, therefore I don't have the feeling that the technology is emotionally connecting with me or is actively helping me. It is giving me suggestions based on their programming, how I can help myself, also by only showing me that there are deviations in the data it is collecting about me. But in the end, it is me who has to deal with distress and it is on me to choose how I want to deal with it. "

"I am using Apple Watch for 5 months and it helps to monitoring my body, but it has not many positive messages like in your examples, positivity can be toxic. When performance is more important than everything there is unhappiness , but if I use the technology to measure my healthy it can be very useful like a tool."

"This was way too many questions asked to form any sort of qualified opinion.
Also this questionnaire makes it seem like you think you can fix human problems with technology. Don't you realize that it is really really bad if you feel lonely and stressed, and instead of having friends you need talk a piece of technology.
Also concerning the wristwatch sportmonitor, there is a very fine line between encouragement and nagging."

"The question were pretty similar and long. Moreover the szenarios were interesting but at the same time different."

"So many similar questions, slightly annoying. But good luck!"

"Tut mir leid das so sagen zu müssen, aber diese Umfrage war eine absolute Katastrophe
Ich hatte das Gefühl 200 mal die gleiche frage zu beantworten und hatte schon nach den ersten 5 keine Lust mehr." *Translation: Sorry to say that, but this questionnaire was an absolute catastrophe. I felt like I was answering the same thing 200 times and lost interest after the first 5 (questions).*

"Pretty long and repetitive. Otherwise, very interesting what is measured in the end."

"I dont know if you need this; [*student id*], but thank you for the experience!"