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A Concise Psychometric Tool to Measure Personal Characteristics for Surviving Natural Disasters: Development of a 16-Item Power to Live Questionnaire

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Received: 14 June 2019; Accepted: 20 August 2019; Published: 23 August 2019



Abstract: The ability of individuals to manage and rebuild their lives after a disaster depends on environmental factors, as well as their own psychological characteristics. A psychometric questionnaire to measure personality traits relevant to disaster survival was proposed based on a large-scale investigation of survivors of the 2011 Great East Japan Earthquake (Sugiura et al. 2015). This tool, the Power to Live with Disasters questionnaire, measures eight personality characteristics that are beneficial for coping with disasters. However, this instrument has not been optimised for practical use; it is long and lacks benchmark scores for the general population. Thus, we developed a concise, 16-item version of the Power to Live with Disasters questionnaire through reanalysis of the 2011 Great East Japan Earthquake survivor data and an additional Web-based survey to obtain normative data from 1200 respondents drawn from the general population of Japan. The scores obtained from the short-form version of the questionnaire successfully replicated the results of the long-form version; eight distinct personality characteristics correlated well with several items associated with “successful survival” of the 2011 earthquake and tsunami. The normative data of the full- and short-version questionnaires were also highly correlated. We propose use of the shortened questionnaire to determine the personality traits critical for survival in the face of unexpected, life-threatening situations caused by natural disasters. Our questionnaire could be useful in schools and other public settings to enhance disaster-mitigation efforts and resilience to disasters in the general population.

Keywords: living in shelters; personality characteristics of survivors; psychometric tool; survival after earthquake; tsunami evacuation

1. Introduction

Day to day survival undoubtedly becomes the primary goal for anyone involved in a natural disaster, including earthquakes and tsunamis. The types of people who are likely to survive a natural disaster remain an unresolved issue in psychology; however, both cognitive and biological factors must play crucial roles. For example, high working-memory capacity (temporary storage and processing of various types of information) is considered a crucial factor in promptly responding to potential dangers under emergency conditions [1–3]. A sound physical condition is also crucial for escaping imminent

dangers during disasters and enduring adverse conditions in their aftermath [4,5]. Other biological factors such as age and sex of the individual are also critical, since the percentage of casualties in areas struck by disaster tends to be higher among elderly/female residents [6,7].

In addition to such mental and physical factors, personality or the personal characteristics of individuals could be of great importance in managing survival in a disaster situation. There is a need to identify the personality characteristics that predict survival under natural disasters including earthquakes and tsunamis. Although there are psychometric tools that measure level of concern regarding disasters [8,9], concern regarding disasters is only one explicitly disaster-related facet of an individual's personality. Until recently, a holistic approach for investigating survival-related personality characteristics in the context of natural disasters has been lacking.

Public interest in such personality characteristics has been sufficiently high for several best-selling books to be published on the types of people who are likely to survive disasters such as earthquakes and tsunamis. For example, the concept of a "Survivor Personality" was proposed by the American author Al Siebert in his bestselling monograph of the same name [10]. Having interviewed many individuals who survived major life events, ranging from disruption of business activities to severe illness, he extracted key factors crucial for survival, including empathy, playful curiosity, a "synergistic personality" and emotional flexibility. Similarly, the investigative journalist Amanda Ripley identified some of the personality characteristics that are common in disaster survivors, including their tendencies to believe in their ability to influence situations, to find meaning in adversity, and to learn from both positive and negative experiences [11].

Considering the generally favourable public response to such survival-related books, there is a need for an evidence-based tool to measure survival-related personality characteristics, to allow people to gauge their own ability to adapt to disasters. Some measures are already in place to scale people's aptitude when it comes to thriving in adverse life events. An example of this focus is the interest in "resilience", a concept increasingly mentioned in the domain of positive psychology and relevant fields of psychological science. Resilience has multiple definitions depending on context, but a widely acceptable definition would be "trait or capacity of a person to bounce back and thrive in difficult situations" (see [12] for a more comprehensive definition and analysis of the concept). People with high resilience can deal with negative situations such as bereavement [13], unemployment [14], or disasters [15] relatively effectively. Although this concept has been well established and is widely utilized in psychological investigations (reviewed in [16]), the focus in relation to this term has not been specifically on 'survival' in extreme situations. Although such situations have many characteristics in common with the adverse situations already associated with resilience, surviving a natural disaster may depend on various other psychological factors. For example, disasters affect many people simultaneously; therefore, those affected are under pressure to ensure their own survival and that of others nearby, sometimes requiring the rapid construction and maintenance of new social relationships. Some other personal characteristics could be of importance for survival in disasters, including a positive disposition toward altruism or beliefs that value society. In this study, we propose a new tool, developed in a bottom-up manner, that will focus specifically on personal characteristics adaptive for surviving a natural disaster, based on real disaster experiences reported by survivors. Such a tool, once established, could be useful in a wide range of contexts relevant to preparation for natural disasters, such as disaster-related education in schools, and public events in local communities aimed at disaster prevention and mitigation.

We recently developed the Power to Live with Disasters questionnaire [17] to address this need. This 34-item questionnaire is based on interview and postal survey data of survivors of the 2011 Great East Japan Earthquake. Although the 34 questions do not explicitly concern respondents' preparations for, or attitudes towards, disasters, they do concern respondents' behaviour during evacuation from tsunami-affected regions and their ability to survive as refugees in shelters. For example, some of the measured personality characteristics were associated with swift evacuation immediately after the occurrence of the earthquake to avoid the tsunami. Other personality characteristics were associated

with successful problem-solving while in the shelters, recovery of physical and mental health, and a positive attitude regarding the process of rebuilding their lives (see Section 4 for more details).

However, the Power to Live with Disasters questionnaire has some major shortcomings hindering its wide-scale application. First, it takes a relatively long time to answer all 34 questions, which are based on six-point Likert scales. If the questions are read carefully such that the respondent spends about 10 s on each, the questionnaire will take roughly 6 min to complete. Although this may not seem like a long time, psychological assessments usually involve multiple tests and personality inventories. When the questionnaire is used in conjunction with other psychological investigations in disaster-related education or training contexts, such as formal classes or safety drills, spending several minutes on one test may be impractical. Hence, it would be preferable if essentially the same instrument could be applied but with markedly fewer questions. Second, while the existence of eight distinct personality characteristics promoting disaster survival was proposed based on survey data from the survivors of the 2011 earthquake, the validity of this eight-factor solution has not been confirmed in the general population. To achieve this, confirmatory factor analysis (CFA) of another dataset obtained from the general population is needed. Third, no benchmark scores for the eight factors exist for the normal population. Normative distributions of the scores should be determined so that respondents can judge their characteristics relative to others; it would also be useful to test whether scores vary between disaster survivors and normal respondents. As our previous study [17] targeted only the survivors of the 2011 earthquake, the sampling was inevitably biased towards those who successfully navigated the disaster and its aftermath. If the questionnaire does indeed measure survival-related personality characteristics, we can reasonably expect survivors to score more highly than the general population.

To address the abovementioned problems, we first aimed to devise a shorter version of the Power to Live with Disasters questionnaire. To shorten the instrument substantially, we included only two questions for each factor; 16 questions were thus extracted such that the eight trait scores were as well-correlated with the original factor scores as possible. We confirmed the validity of the short-form instrument using the same survival indices as applied in our previous study [17]. Second, we aimed to determine the representability and reliability (internal consistency) of the short-form questionnaire data using another dataset from the general population. To confirm the utility of the short-form questionnaire as a concise alternative to the full version, we calculated Pearson correlation coefficients between their scores. Correlations exceeding 0.90 were taken to indicate sufficient representativeness of the short-form items. The Spearman–Brown coefficient of each factor was also calculated to evaluate the reliability of the two-item factor solution used in the short-form questionnaire. We also conducted a CFA to assess the discriminability of the eight factors in the short- and long-form questionnaires, based on normative data. Third, we aimed to confirm further the validity of the Power to Live with Disasters questionnaire as a tool for measuring personality characteristics pertinent to disaster survival by comparing the data of the survivors and general population. Assuming that the eight factors identified are truly representative of survival-related personality characteristics, we expected the scores of the survivor group to be higher than those of the respondents from the general population; differences between the two groups were analyzed while controlling for the effects of age and sex. Finally, we examined the discriminant validity of the two forms of the Power to Live questionnaire by utilising a widely accepted questionnaire considering the Big Five personality factors [17].

2. Materials and Methods

2.1. Overview of the Data Collection and Analyses

We utilized data from two populations. First dataset was a part of the data collected in a postal survey of survivors of the 2011 Japan earthquake (reported in our previous study [17]). Second dataset was novel responses collected from normative population in 2015 through an internet survey. In both surveys, the same 34-item questions for Power to Live factors were used. With survivors, we had also

collected indices of successful survival through the earthquake and its aftermath (see Supplementary Table S1; the data were also reported in our previous study [17]). We used the two datasets to achieve the three goals delineated above. First, we re-analyzed the survivor data of the 34 Power to Live questions to select a subset of questions for a shortened version of the questionnaire. Then we used the five indices of successful survival to validate the short-form questionnaire. Second, we used the second dataset to examine the reliability and validity of the short-form Power to Live questionnaire. We tested how much of the variances in the original long-form Power to Live scores can be represented with the reduced set of questions. Finally, we used both datasets to compare Power to Live scores between Survivors and Normative population. This last analysis was for further validation of the two forms of Power to Live inventory based on a prediction that survivors are likely to have overall higher scores than normative group if the scores indeed represent personality factors beneficial for disaster survival.

Protocols for the questionnaire surveys were reviewed and approved by the Ethics Committee for Surveys and Experiments at the Graduate School of Arts and Letters, Tohoku University (2012-1019-190749). The purposes of the surveys were presented to participants before they were prompted to answer any questions. Participants were instructed to answer the questions and return the completed questionnaire if they agreed to participate in this research. All survey data described below were collected and analyzed anonymously throughout this study. During all stages of this study, the authors adhered to the ethical standards of the Declaration of Helsinki.

2.1.1. Dataset 1: Survivor Data

Data were collected during a large-scale investigation of the 2011 Great East Japan Earthquake survivors, nearly 3 years after the event. A total of 1412 respondents (564 males and 832 females in their 20s to 80s) filled in and returned the postal questionnaire. For this study we only utilized their responses to the 34 Power to Live questions (Supplementary Table S1) and five self-rated indices of successful survival after the earthquake. The five indices were: (1) tsunami evacuation (whether the respondent took evasive action immediately after becoming aware of the earthquake); (2) refugee-related problem-solving (the degree to which respondents resolved various problems related to life in the shelters); (3) reconstruction of their life (the extent to which each survivor felt they had been able to rebuild their life in the 3 years after the earthquake); (4) physical health; and (5) mental health (how they maintained and recovered their physical and mental health, respectively, over the 3-year post-disaster period) (see also Supplementary Table S2). The details of the survey are reported in our previous paper [17].

2.1.2. Dataset 2: Normative data

This dataset was collected from 1200 respondents drawn from the general population through an online survey. The online data collection was conducted by a crowdsourcing company, Cross Marketing Inc. (Tokyo, Japan) between 5–11 of August 2015. The respondents were recruited from among the company's registered pool of possible online crowdworkers living in any of the 47 prefectures of Japan. They were asked to answer the 34 Power to Live questions in exchange for an online voucher/shopping points (worth a few hundred yen). Because the results of our previous study [17] implied that some of the factor scores vary by age and sex, the present respondents were stratified into six age (20s, 30s, 40s, 50s, 60s, and 70s to 80s) and two sex (male or female) classes. Data from 100 respondents were collected for each class. We also administered another questionnaire to measure the well-established Big Five personality traits: openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism (TIPI-J: Ten-Item Personality Inventory in Japanese; [18]). We used these data to assess the discriminant validity of Power to Live scores.

2.2. Data Analysis

2.2.1. Extraction of Representative Questions and Re-Validation of the Short-Form Scores Using the Survivor Dataset

We aimed to extract a representative pair of questions for each of the eight personality factors. To identify the optimal question pairs, we applied all possible combinations of two items for each factor; the pairs showing the strongest correlations with the factor scores of the long-form Power to Live with Disasters questionnaire were selected. To assess the reliability of the new scores, the Spearman–Brown coefficient was calculated for each pair of questions.

We also investigated whether the relationship between the eight factors and survival indices observed in our previous study [17] was maintained when using the short-form questionnaire data. The previous study reported significant correlations between survival outcomes and personality factor scores. There were 16 significant associations between the original Power to Live with Disasters factors and the five survival indices. To verify the relationship between the short-form scores and tsunami evacuation, respondents were divided into fast (immediate evacuation) and slow (delayed evacuation) groups and their scores for the eight personality factors were compared using an unpaired t-test. Spearman's correlation coefficients were calculated to determine the relationships between the eight factors and the other four survival indices. In addition, we assessed the discriminant validity of the short-form Power to Live with Disasters scores. We calculated Pearson's correlation coefficients between the eight Power to Live scores and TIPI-J scores. We expected that the correlation coefficients would not be excessively high for any combination of scores.

2.2.2. Confirmation of the Reliability of the Short-Form Power to Live with Disasters Questionnaire Using the Normative Dataset

We analyzed the normative dataset to assess the reliability of the short-form Power to Live with Disasters questionnaire. First, correlations between the long- and short-form questionnaire scores were calculated for all eight personality factors. High correlations ($r > .90$) were required for the short-form scores to be considered sufficiently representative of the variance associated with the long-form questionnaire. The Spearman–Brown coefficient for the two-item scores was also calculated for each factor using the short-form data to determine the reliability of the eight short-form factors.

We also carried out a CFA of the long- and short-form data to determine the extent to which the new data matched the original eight-factor solution of the original, exploratory factor analysis [17]. The analyses were performed using R software (R Development Core Team, Vienna, Austria) running the package “lavaan” [19]. In both cases, the responses to the questions were the dependent variables and each question was associated with one of eight latent variables. In the long-form model, all the 34 items were used. The correspondence between factors and questions was assessed based on our original report ([17]; see also Supplementary Table S1). Three, four or five questions were associated with each of the eight factors. For the short-form model, 16 questions extracted from the full questionnaire were used as pairs of items associated with a given factor. Using the maximum-likelihood method, we calculated goodness-of-fit indices for each model, including the comparative fit index (CFI), Tucker–Lewis index (TLI), standardized root mean square residual (SRMR), and root mean square error of approximation (RMSEA). According to theoretical and empirical reports, CFI > 0.95, TLI > 0.95, SRMR < 0.06, and RMSEA < 0.06 are considered to indicate good fit of a model to the data [20].

2.2.3. Validation of the Long- and Short-Form Questionnaires: Comparison of the Survivor and Normative Datasets

We combined the two datasets detailed above to investigate differences in the Power to Live with Disasters scores between survivors and the general population using a general linear model (GLM). The two datasets were obtained from different target populations, so the distributions of the scores

were expected to differ. The biggest difference was obviously experience of a disaster; the respondents in the first dataset were assumed to have coped relatively successfully with the 2011 earthquake and tsunami, living through the difficult situation and rebuilding their lives to such an extent that they were able to reflect and answer questions based on their experiences. Thus, the survivor data would have been subject to considerable sampling bias towards those who adapted successfully. Accordingly, the survivors' scores on the Power to Live with Disasters questionnaire were necessarily higher than the normative scores, i.e., those of the general population. We expected to obtain additional convergent evidence by comparing the survivors' data directly to the normative data. As the original Power to Live with Disasters scores were influenced by participants' sex and age [17], we used a GLM to partial out the effects of these two factors and investigated the effect of group (survivor/normative) on questionnaire scores; R was employed for this analysis. All eight factors were modelled based on the short- and long-form scores.

3. Results

3.1. Extraction of Representative Questions and Re-Validation of the Short-Form Scores Using the Survivor Dataset (Results of Analysis 2.2.1)

Table 1 shows the pairs of questions selected for each factor, i.e., those having the highest correlation with the original factor scores. The Pearson correlation coefficients were greater than or equal to 90 for all factors, which indicates good approximation of the original factor scores using only two questions; the Spearman–Brown coefficients were moderate [21]. Table 2 shows the relationships of the eight personality factors with tsunami evacuation: the scores for F1 (leadership), F2 (problem-solving), and F6 (emotional regulation) were significantly higher in the fast-evacuation group than in the delayed-evacuation group. Table 3 shows the correlations of the eight personality factors with the remaining four survival indices. Replicating the results of the original inventory [17], there were significant correlations between all eight personality factors and the survival indices. Regarding refugee-related problem-solving, we detected significant correlations with problem-solving (F2), altruism (F3), etiquette (F5), and emotional regulation (F6). Active well-being (F8) was significantly correlated with the rebuilding one's life. Several factors were significantly correlated with recovery of physical or mental health. Specifically, active well-being (F8) had a significant positive correlation with recovery of physical health, while etiquette (F5) was significantly negatively correlated with recovery of physical health. In the case of recovery of mental health, leadership (F1), problem-solving (F2), emotional regulation (F6), and active well-being (F8) showed significant positive correlations. In sum, the previously observed 16 significant associations between the Power to Live with Disasters factors and survival indices were confirmed by the current analysis, except for the correlations between refugee-related problem-solving and self-transcendence (F7), reconstruction of life and altruism (F2), and physical health and etiquette (F5).

Table 1. Means and standard deviations (SDs) of selected items with each factor, and their reliability indices.

Factor	Label	Item	<i>r</i>	<i>ρ</i>	Mean (SD)
F1	Leadership	To resolve problems, I gather together everyone involved to discuss the matter. In everyday life, I often take the initiative to gather people together.	0.93	0.77	4.21 (2.42)
F2	Problem Solving	When I am fretting about what I should do, I compare several alternative actions. To resolve a problem, I first of all initiate action.	0.90	0.76	6.29 (2.03)
F3	Altruism	I like it when other people rely on me and are grateful to me. When I see someone having trouble, I have to help them.	0.90	0.58	6.51 (1.91)
F4	Stubbornness	I am stubborn and always get my own way. I unhesitatingly say whatever it is I want to say.	0.90	0.61	5.29 (2.20)
F5	Etiquette	On a daily basis, I take the initiative in greeting family members and people living in the neighborhood. When someone has helped me or been kind to me, I clearly convey my feelings of gratitude.	0.92	0.66	8.11 (1.85)
F6	Emotional Regulation	During difficult times, I endeavor not to brood. During difficult times, I endeavor to think positively, telling myself that this experience will benefit me in the future.	0.95	0.74	6.38 (2.12)
F7	Self-transcendence	I am aware that I am alive, and have a sense of responsibility in living. I am aware of the path and teachings I should follow as a person.	0.93	0.76	7.21 (2.03)
F8	Active Well-being	In everyday life, I have habitual practices that are essential for relieving stress or giving me a change of pace. In everyday life, I endeavor to find opportunities to acquire new knowledge, skills, and attitudes.	0.92	0.69	5.70 (2.36)

r: Pearson's correlation of the two-item solution with the corresponding original factor scores. *ρ*: Spearman–Brown coefficients for the two-item solution with their corresponding factors.

Table 2. External validity of short-form Power to Live with Disasters scores with respect to tsunami evacuation. The *t*-values indicate statistical differences in scores between immediate evacuees ('yes' responses) and non-immediate evacuees ('no' responses). *: $p < 0.05$, **: $p < 0.0063$ (Bonferroni-corrected for multiple comparisons).

Attribute	Level	N	F1	F2	F3	F4	F5	F6	F7	F8
Immediate tsunami evacuation	Yes	449	4.47	6.60	6.76	5.39	8.37	6.71	7.50	6.00
	No	394	4.14	6.28	6.58	5.36	8.20	6.35	7.40	5.71
	<i>t</i> (841)		2.04 *	2.47 *	1.45	0.22	1.60	2.76 *	0.78	1.85
	Cohen's <i>d</i>		0.14	0.17	0.10	0.02	0.11	0.19	0.05	0.13

Table 3. External validity of short-form Power to Live with Disasters data with respect to four indices of survival. Data are means and standard deviation (SD) for each survival index, numbers of respondents who provided data, and correlation coefficients. *: $p < 0.05$, **: $p < 0.0063$ (Bonferroni-corrected for the number of factors). RPS: refugee-related problem-solving. PH: physical health. MH: mental health.

Attribute	Mean \pm SD	N	F1	F2	F3	F4	F5	F6	F7	F8
RPS (%)	34.0 \pm 30.4	1200	0.043	0.105 **	0.063 *	0.030	0.061 *	0.111 **	0.037	0.055
Reconstruction (%)	69.3 \pm 29.4	896	0.033	0.020	−0.030	−0.018	0.015	0.025	0.028	0.077 *
PH	−0.59 \pm 1.43	1252	0.056 *	0.052	−0.034	0.064 *	−0.053	0.074 *	−0.028	0.085 **
MH	−0.55 \pm 1.59	1255	0.094 **	0.085 **	−0.035	0.037	−0.025	0.123 **	0.018	0.143 **

3.2. Confirmation of the Reliability of the Short-Form Power to Live with Disasters Questionnaire Using the Normative Dataset (Results of Analysis 2.2.2)

The correlation coefficient between the long- and short-form scores was greater than 0.90 for all factors [$r = 0.92, 0.90, 0.91, 0.90, 0.95, 0.93, 0.94$, and 0.95 for F1–F8, respectively], indicating that more than 81% of the variance in the long-form scores for each factor could be explained by just one pair of questions. We also calculated Spearman–Brown coefficients to assess the reliability of the two-item scales. The correlations were moderate for all factors ($\rho = 0.78, 0.73, 0.79, 0.52, 0.71, 0.81, 0.76$, and 0.69 for F1–F8, respectively).

The CFA of the normative data in short-form model showed a good fit (CFI = 0.96, TLI = 0.94, SRMR = 0.031, and RMSEA = 0.056). The CFA of the long-form model yielded slightly lower goodness of fit values, but they were still close to the threshold values for a good fit (CFI = 0.86, TLI = 0.84, SRMR = 0.059, and RMSEA = 0.072).

Coefficients of the correlation between Power to Live and Big Five scores for the normative dataset are shown in Table 4A,B for the short and long forms, respectively. All correlations between these two personality inventories were positive but not too high. The maximum value was $r = 0.43$ for long-form scores (between Extroversion and Leadership) and $r = 0.39$ for short-form scores (between Extroversion and Active well-being).

Table 4. (A) Coefficients of the correlation between the eight Power to Live factors (short-form scores) and Big Five personality factors. (B) Coefficients of the correlation between the eight Power to Live factors (long-form scores) and Big Five personality factors.

(A)								
	F1	F2	F3	F4	F5	F6	F7	F8
Extroversion	0.38	0.32	0.33	0.20	0.27	0.31	0.31	0.39
Agreeableness	0.29	0.21	0.33	0.24	0.16	0.15	0.24	0.24
Conscientiousness	0.17	0.20	0.23	0.18	0.12	0.14	0.19	0.24
Neuroticism	0.13	0.14	0.22	0.13	0.09	0.11	0.15	0.20
Openness	0.11	0.14	0.22	0.15	0.14	0.15	0.18	0.17

(B)								
	F1	F2	F3	F4	F5	F6	F7	F8
Extroversion	0.43	0.36	0.35	0.23	0.28	0.33	0.35	0.40
Agreeableness	0.30	0.21	0.36	0.27	0.14	0.16	0.25	0.23
Conscientiousness	0.16	0.20	0.24	0.25	0.12	0.17	0.18	0.21
Neuroticism	0.14	0.18	0.23	0.17	0.10	0.17	0.18	0.21
Openness	0.12	0.17	0.23	0.19	0.14	0.18	0.2	0.17

3.3. Validation of the Long- and Short-Form Questionnaires: Comparison of the Survivor and Normative Datasets (Results of Analysis 2.2.3)

The mean short- and long-form Power to Live with Disasters questionnaire scores calculated for each sex and age class, from each of the survivor and normative datasets are shown in Supplementary Tables S3 and S4. The number of respondents aged 80 years or above was too small in both the survivor data ($n = 4$ of 1254) and the normative data ($n = 18$ of 1200), so these respondents' data were excluded from the calculations of the means. It should be noted that the survivor data were not collected using a stratified sampling method, so the numbers of respondents varied significantly between classes in the survivor dataset.

We used a GLM to investigate the differences between the two groups in terms of their short-form questionnaire scores, and found that the survivors had higher scores than the normative population for factors 2, 3, 5, 6, 7, and 8 (t -values > 4.76 , p -values < 0.001) after partialling out the effects of age and sex. There were no significant differences between groups for factors 1 and 4 (t -values < 0.50 ,

p -values > 0.10). The GLM of the long-form data indicated significantly higher scores for survivors versus the normative population for all eight factors (t -values > 30.79 , p -values < 0.001).

4. Discussion

4.1. Validation of the Short-Form Power to Live Scores

We constructed and validated a concise version of the Power to Live with Disasters questionnaire by reanalyzing survey data collected from the survivors of the 2011 Great East Japan Earthquake disaster and carrying out new analyses on normative data. The survivor data showed that the short-form questionnaire scores matched the long-form scores well (r -values > 0.90 ; Table 1) and confirmed the validity of the eight factors identified by the long-form questionnaire as being important for disaster survival [17] (Tables 2 and 3). Our current results indicated that most of the previously observed significant relationships between factor scores and survival indices could be reproduced with the short-form questionnaire. The factors with significant association with tsunami evacuation (F1, F2, and F6) were exactly the same as our previous study [17]. The correlations with other four survival indices also largely matched with the previous study. Namely, the current results showed 11 replications of the original 14 significant correlations. There were, however, a few other significant correlations observed only with the short-form scores; namely the F5-RPS and F1-PH correlations shown in Table 3. These discrepancies could have been due to the marginal significance of some of the correlations in the original and current analyses. It is worth noting that the associations that were significant at the Bonferroni-corrected level in the previous study were all confirmed in the current reanalysis. This demonstrates that the pairs of questions selected to represent each factor were suitable. The validity of the short-form data was strongly supported by the results of these reanalyses.

The normative data confirmed the reliability of the short-form scores, which showed strong Pearson correlations with the long-form scores ($r > 0.90$ for all factors); the Spearman–Brown coefficients were of moderate strength (mean $\rho = 0.68$). Our analyses of the normative data also showed strong correlations between the short- and long-form data, as well as high internal consistency regarding the personality factors. Furthermore, CFA showed that the short-form scores had a better correlation with the eight-factor model than the long-form scores. The results of our CFA further indicated that the short-form data fitted the model better than the long-form data, i.e., eight factors can be better-distinguished using the short-form (16-item) questionnaire than using the long-form (34-item) questionnaire.

Furthermore, discriminant validity with the widely-accepted Big Five personality factors was confirmed in the correlation analysis of the normative data (Table 4A,B). The discriminability of Power to Live from Big Five was suggested in our previous study of responses from a total of 301 university students [22]. With a substantially larger sample, from a much wider range of age groups, we consider that the current results provide conclusive evidence for the discriminant validity of the Power to Live scale with respect to the Big Five personality traits.

Given the above results, we consider the present 16-item Power to Live questionnaire has sufficiently high reliability and validity, and hence can be used when a shorter questionnaire for the eight factors of Power to Live with Disasters is in need. The results of our CFA further indicated superiority of the short-form questionnaire, as the short-form data fitted the eight-factor model better than the long-form data. This means the eight factors can be better-distinguished using the short-form questionnaire. In fact, the excluded questions had high factor loadings on multiple factors in the original factor analysis [17]. For example, a question removed from the leadership factor, (F1; “In everyday life, I make sure to keep in contact with friends and acquaintances”), had a >0.15 factor loading on three factors: leadership (F1), etiquette (F5) and active well-being (F8) in the original, exploratory factor analysis [17]. Improved model fit through shortening a multi-factor questionnaire has been reported in several other psychometric studies. For example, a study that developed a short version of a psychological questionnaire to measure the personality characteristic of “grit” [23] reported a

substantial improvement in the fitting indices after omitting 4 of the original 12 items. Similarly, other psychometric studies on questionnaires to measure the widely accepted Big Five personality factors (extraversion, agreeableness, neuroticism, conscientiousness, and openness) indicated that the collected data matched the five-factor model of personality better when a limited number of representative questions was selected for each factor from among the original 50 items pertaining to the five aspects of personality [24,25]. These reports imply that, while having more questions to measure the same set of psychological factors has merit for covering a wide range of associated characteristics, short-version questionnaires are advantageous for discriminating between different factors by omitting questions associated with more than one factor.

In this study, however, the superiority of the short-form Power to Live with Disasters questionnaire was partially undermined by our final GLM. In the comparison between survivor and normative data after partialling out the effects of age and sex, survivors had consistently higher scores than the general population in all of the eight factors on the long-form questionnaire. On the short-form questionnaire, however, there was no significant differences between the two groups in two of the eight factors: Leadership and stubbornness. It is possible that some of the questions removed from these two factors were more sensitive to disaster-survival-related traits than those that were retained.

Although the long-form questionnaire could be superior in terms of precise measurement of the survival-related personality characteristics, we consider that the short-form Power to Live with Disasters questionnaire is more practical than the original questionnaire as it has sufficient validity and reliability for investigating survival-related personality characteristics. The new instrument takes substantially less time to complete, allows for easier data handling due to the balance in the number of items across factors (i.e., two per factor), and could easily be combined with other questionnaires in future surveys. The present paper provides benchmark scores of both short- and long-form questionnaire for different age and sex classes (Supplementary Tables S3 and S4). Thus, respondents may compare their scores to the corresponding benchmark scores in normative population and/or to those of the actual survivors of the 2011 Great East Japan Earthquake to think about how much Power to Live s/he might have in surviving a potential disaster.

4.2. Relationship with Resilience

As briefly mentioned in the Introduction, we consider the psychological concept most related to the Power to Live with Disasters to be resilience. This concept has been increasingly mentioned over the past two decades in psychological science. People with high resilience are reported to be able to overcome severe difficulties in life much better than can those with low-resilience. [26,27]. Features that characterize resilient people include having high perseverance [28], trusting one's instincts [29], and having external resources such as family cohesion and well-maintained social relationships with family and friends [30]. Several psychological inventories have been developed to measure resilience; the first attempt, using a 25-item self-reporting questionnaire, was presented in a study by Wagnild and Young [28]. More than a dozen different questionnaires have been proposed since that study (reviewed in [16]). Some components of these early questionnaires correspond with Power to Live factors.

For example, the ability to construct and manage social relationships is incorporated into resilience scales. "Social competence" is a major factor of resilience in the scale proposed by Friborg et al. [30]. Items related to this factor assess the respondent's competence in building and maintaining good relationships with others such as getting in touch with new people or establishing new friendships. A part of resilience is also similar to F1 (leadership) in the Power to Live scale, in that both assess the respondent's ability to enhance communication with others. Similar components are also involved in the Scale of Protective Factors (SPF), a recently proposed resilience scale [31] that includes questions about competence in constructing and maintaining social relationships (e.g., "I am good at starting new conversations" or "I am good at interacting with others"). A Japanese resilience scale developed by Hirano [32] also measures respondent's sociality as one of its seven factors. Despite these apparent similarities, a critical difference between the social component of the Power to Live and resilience could

be that the former seems to measure an individual's tendency to take initiative in social communication (thus the factor was named "leadership") while the latter seems to measure more general social skills. Although some disaster-management studies so far have emphasized the importance of leadership in members of military or medical teams [33,34], it is quite interesting to ask how and why quality of leadership in a survivor can have positive effects on that person's physical and mental states after the disaster. The precise mechanisms of the roles of leadership and social skills in disaster situations would be worth investigating in future studies.

Another similarity between resilience scales and the Power to Live factors is mental and physical self-control. For example, the "personal structure" subscale in Friborg's resilience scale includes items conceptually similar to F2 (problem solving) or F8 (active well-being). Specifically, this subscale involves statements such as "I prefer to plan my actions" and "I am good at organizing my time", which measure proactive personal traits, which are partly reflected in F2 questions. Other items in the subscale, such as "I keep up my daily routines even at difficult times" and "Roles and regular routines make my daily life easier" overlap with F8 questions, as both reflect the degree of spontaneous control over the respondent's daily activities.

Since resilience assesses a subject's personal resources in relation to recovering from negative life events, it should inevitably have similarities with the Power to Live concept. However, we assume that these concepts differ in at least two aspects. First, the Power to Live questionnaire measures only personal characteristics adaptive for survival. Therefore, the questions relate only to personal traits or personal habits, whereas social relationships and family coherence are essential factors of many resilience scales. This difference makes the Power to Live questionnaire a more suitable tool for the psychological assessment of successful survivors, independently of their available family and/or societal resources. Second, as described above, the Power to Live scale is expected to explain the ability to react rapidly to a deadly risk such as a tsunami. A focus on proactive relationships in combination with lethal dangers is beyond the scope of resilience scales. Resilience, by definition, focuses on the capacity to endure and/or recover from stress or traumatic damage. Therefore, the Power to Live concept is broader and more inclusive than resilience. A few questionnaire components, such as stubbornness (F4) and etiquette (F5), do not appear to be directly measured in resilience scales. Further studies are needed to clarify definitively the similarities and differences between Power to Live and resilience scales.

4.3. Limitations of This Study and Future Directions

Although the current study provides sufficient validation to assess the usefulness of the short-form Power to Live questionnaire, it has some limitations. First, the short-form questionnaire has not been tested independently. Therefore, responses to the 16 questions may have been influenced by a potential carry-over effect by reading 18 other questions. Future studies using this reduced set of questions should be encouraged to further confirm the validity of this inventory. Second, the convergent validity of the questionnaire should be examined in the near future. We predict that the eight Power to Live scores have fairly high positive correlations with psychological resilience, as both of the concepts concern traits required to outlive difficult circumstances. Accomplishing both convergent and discriminant validity with this questionnaire would help place the Power to Live more firmly in the nomological network of human personality. Third, although the authors assume that the questionnaire will be of great value in disaster-management education in schools, the questions may be too difficult for young children to interpret. We are currently developing a modified questionnaire applicable to primary school pupils in Japan (aged 6–12 years). Similarities and differences between responses from adults and children should be further validated before the Power to Live questionnaire is used in public education contexts. Fourth, the surveys proposed in this study were not applied to minority populations, who should receive greater consideration with regard to post-disaster recovery. For example, people who do not define themselves on a binary gender scale could not participate in these surveys because there is no third sex/gender option. Other minorities such as immigrants,

optically-challenged people, or with poor or no literacy in Japanese would not have been motivated to participate in these surveys. Because the impact of a natural disaster can be substantially more severe among certain minority populations [35,36], future attempts should be made to achieve more inclusive designs for the Power to Live or other disaster-related personal feature scales beyond the normative population. Finally, because the original postal survey for survivors of the 2011 earthquake was retrospective, differences in Power to Live scores between survivors and normative populations may be partly attributable to “posttraumatic growth” [37,38]. Whether the eight factors reflect unchanging or malleable characteristics of individuals is an important issue that deserves further investigation before considering the potential applications of this inventory in disaster education.

Despite these limitations, the Power to Live questionnaire can potentially explain or predict tangible outcomes following a disaster. Both long- and short-form scores were well associated with appropriate evacuation responses to tsunami risk, positive activities in shelters, and long-term life reconstruction, as well as mental and physical health. We believe that the tool introduced in this study will generate more interest in natural-disaster adaptation, encouraging people to imagine how they would survive in a disaster situation based on their personality characteristics. We expect that the short-form Power to Live with Disasters questionnaire could also be used to assess respondents’ probability of successfully surviving disaster settings other than earthquakes, such as torrential rain, hurricanes, heat waves, and volcanic eruptions. In any natural disaster, individuals must prepare well and respond quickly to a situation if they are to survive. The personality traits discussed in this paper should be further explored in future surveys to validate their associations with surviving other types of natural disasters, as well as other difficult life events.

5. Conclusions

The current study proposes a more practical short-form Power to Live with Disasters questionnaire, developed based on interviews and surveys of the survivors of the 2011 Great East Japan Earthquake. The 16-item questionnaire showed high consistency with the original instrument, with respect to the five self-rated indices of successful survival. Thus, the personality trait data obtained using this questionnaire can be used to estimate the probability that an individual will survive a disaster and subsequent difficult life situations.

Of course, factors other than the Power to Live personal characteristics could be of great importance for disaster survival too. In our normative data, men in their 70s have the highest sum scores of Power to Live (Supplementary Table S4), but it does not necessarily mean this group simply has the highest probability to successfully survive a natural disaster. In fact, our data of the survivors of 2011 earthquake indicate that the ratio of immediate evacuation from the tsunami risk was highest in women in their 30s (see the open-access data from [17]; for more detailed analyses focusing on tsunami survival, see another report from our group [39] in this issue). As we briefly introduced at the beginning of this paper, other factors such as cognitive, physical and socioeconomic ones are known to contribute successful survival in a disastrous situation. The Power to Live questionnaire, in this sense, is just a tool to measure the survival-related personal characteristics and must be used with other survival-related sociometric/psychometric measures to correctly estimate a person’s likelihood of successful survival. The association between Power to Live and other survival related factors should be of great importance for the advancement of psychological approach to disaster survival and is worth exploring in future studies.

We expect the questionnaire developed herein to enhance awareness of, and preparation for, possible disasters through use by schools and local communities, possibly as an adjunct to anecdotal and practical knowledge regarding how to prevent damage in case of a disaster. The short-form Power to Live with Disasters questionnaire has the benefit of being easy to complete. It is also easy to calculate the factor scores, the validity of which with respect to their associations with several aspects of disaster survival were confirmed in both this study and our previous one.

Supplementary Materials: The following are available online at <http://www.mdpi.com/2076-3263/9/9/366/s1>, Table S1: The original 34 questions in the full power-to-live questionnaire; Table S2: Questions to acquire the five survival indices; Table S3: Mean scores of the eight Power to Live factors in the survivors of 2011 earthquake; Table S4: Mean scores of the eight Power to Live factors in the normative population. Supplementary data: Raw responses from normative population to Power to Live and Big Five inventories.

Author Contributions: Conceptualization, R.N., A.H., T.A., and M.S.; methodology, M.S.; formal analysis, R.I.; investigation, R.N., A.H., T.A., and M.S.; data curation, M.S.; writing—original draft preparation, R.I.; writing—review and editing, R.I., R.N., A.H., T.A., and M.S.

Funding: The survey of survivors' personality characteristics was supported by the Special Project Research (H24-A-5 and H25-A-4) of the International Research Institute of Disaster Science, Tohoku University (Sendai, Japan). The collection of the normative data via the online survey was supported by Topic-Setting Program to Advance Cutting-Edge Humanities and Social Sciences Research (<http://www.jsps.go.jp/english/e-kadai/index.html>). Preparation of the manuscript was partially supported by a grant (KAKENHI 17H06219) from the JSPS.

Acknowledgments: We are grateful to Yutaka Matsuzaki for his advice on CFA.

Conflicts of Interest: The authors declare no conflict of interest.

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