Perceived and Actual Growth Following Hematopoietic Stem-Cell Transplantation: Longitudinal Evidence of Greater Decline than Growth

M. Corman
Universite Clermont Auvergne et associes

M.-T. Rubio
Centre Hospitalier Universitaire de Nancy

A. Cabrespine
Centre Hospitalier Universitaire de Clermont-Ferrand

I. Brindel
Hopital Saint Louis

J.-O. Bay
Centre Hospitalier Universitaire de Clermont-Ferrand

Peffault De La Tour
Hopital Saint Louis

Michael Dambrun (✉ michael.dambrun@uca.fr)
Universite Clermont Auvergne et associes

Research article

Keywords: Hematopoietic Stem Cell Transplantation, Perceived Post-Traumatic Growth, Actual Post-Traumatic Growth, Psychological Dispositions, Acceptance, Dispositional Mindfulness, Experiential Avoidance

DOI: https://doi.org/10.21203/rs.3.rs-42470/v1

License: ☒ This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License
Abstract

**Background.** This prospective longitudinal study examined perceived and actual changes in post-traumatic growth following Hematopoietic Stem-Cell Transplantation (HSCT) and their relationships with mental health and psychological disposition. We also tested the hypothesis that unwillingness to be in contact with distressing thoughts and feelings—i.e. experiential avoidance—would moderate the relationship between Post-Traumatic Stress Disorder (PTSD) and growth.

**Methods.** This study was carried out with 187 patients. All patients completed the Post-Traumatic Growth Inventory (PTGI) five months after HSCT and also scales tapping into the five domains of PTGI during and 5 months after HSCT. Mental health and psychological disposition were also assessed prior to hospitalization. A PTSD scale was administrated at the five-month follow-up.

**Results.** Perceived and actual change were weakly correlated. Bayesian pre/post-HSCT comparisons in actual growth revealed substantial to very strong decline in four of the five dimensions assessed. Overall, RCI indicated a reliable increase for 5.6% of patients and a reliable decrease for 40.8% of patients. Confirming that perceived and actual growth reflect different processes, they were not related to the same mental health and psychological disposition variables. Moreover, the hypothesis that acquiring positive outcomes from a traumatic event, such as HSCT, requires direct confrontation with the source of distress that was supported in the case of perceived growth but not in the case of actual growth.

**Conclusions.** Retrospective measures such as the PTGI do not appear to assess actual pre- to post-HSCT change. HSCT seems more linked to psychological decline than to growth.

Background

Hematological malignancies and the side effects of treatments are particularly distressful and disturbing for the mental health and quality of life of patients [1, 2]. Hematopoietic Stem Cell Transplantation (HSCT) is associated with fatigue, pain, anxiety, depression and Post-Traumatic Stress Disorder (PTSD) [3–5]. However, several studies suggest that cancer and its treatment may be accompanied by a process of psychological recovery and growth. Some theorists even propose that growth requires the presence—and a direct confrontation with the source—of distress [6–8]. However, problematically, this area of research is subject to significant criticism and controversy, raising important doubts not only about the existence of post-traumatic psychological growth following cancer and its treatment, but also about the processes involved [9–13].

Post-traumatic growth refers to a positive psychological change following a traumatic life event [8]. The Post-Traumatic Growth Inventory (PTGI) is the most commonly used instrument to assess growth following an adverse event [14]. However, it does not assess actual change but self-perceived growth. Numerous studies have highlighted the limitations of retrospective self-perceived measures such as the PTGI, which were recently summarized by Infurna and Jayawickreme [12] as follows: “PTGI may reflect meaningful personality change to some degree but also maladaptive reality distortions, selective
appraisals, coping strategies, personality characteristics, ways of explaining emotion levels, reflections of people's implicit theories of change, and beliefs that their past selves were worse than they actually were." (p. 3–4). The Janus model proposed two components of PTGI: a constructive component and an illusory one [15]. The illusory nature of the PTGI was empirically supported by the study by Frazier et al. [11], who concluded that this type of instrument does not appear to measure actual change. Furthermore, when comparing scores for actual change between before and after trauma, Frazier et al. did not find more evidence for a reliable psychological growth than decline, raising serious doubts concerning the very existence of post-traumatic psychological growth following trauma. This lack of robust empirical evidence, accompanied by significant methodological limitations, lead Infurna and Jayawickreme [12] to recommend (a) caution when interpreting studies using retrospective self-perceived measures, and (b) the use of prospective longitudinal designs that allow a more reliable assessment of the change between before and after the adverse event. Thus, we conducted a prospective longitudinal study among hematological cancer patients.

Studying post-traumatic growth in the case of cancer implies taking into account the specific circumstances related to this context. Sumalla et al. [16] indicate that cancer is a particularly aversive event and a number of characteristics need to be delineated. Among these, it may be difficult to identify a single stressor. There may be the diagnosis of the disease, its severity, the prognosis, the aggressiveness of treatment, etc. In order to limit confounding factors, in this study we have only focused on HSCT and the participants were asked to give their feelings and thoughts only in reference to this aversive event. Thus, we conducted a prospective longitudinal study in which we followed three main objectives: (a) to compare perceived to actual growth in the context of HSCT, (b) to examine their relationships with mental health and psychological dispositions, and (c) to test the hypothesis that acquiring positive outcomes from a traumatic event, such as HSCT, requires direct confrontation with the source of distress.

To compare perceived to actual growth we drew inspiration from Frazier et al. [11]. Perceived growth was assessed with the PTGI at five months after HSCT. Actual growth was measured using scales that capture the five domains of growth assessed by the PTGI (i.e. relating to others, new possibilities, personal strength, spirituality change, and appreciation of life). Actual growth was measured twice: during the week of the transplantation at the hospital and at the 5-month follow-up. We also examined the correlations between the five domains of perceived and actual growth.

To go further in the study of the differences and similarities between perceived and actual growth, we also studied their relationships with mental health and several psychological dispositions that we assessed three weeks prior to hospitalization for HSCT. Concerning mental health, we selected anxiety, depression and happiness. Concerning psychological dispositions, we selected optimism, acceptance, extraversion and the five facets of dispositional mindfulness. According to the meta-analysis of Shand et al. [17], psychological growth following HSCT should be positively related to optimism and negatively related to a poor mental health. Recent research reveals that dispositional mindfulness and acceptance, a core construct of acceptance and commitment therapy, are beneficial psychological resources that could
facilitate post-HSCT recovery [18, 19]. Thus, we predicted that acceptance and dispositional mindfulness, especially the non-judging and non-reacting facets [20], would facilitate genuine growth.

Finally, we tested the prediction that post-traumatic growth requires direct confrontation with the source of trauma using both perceived and actual measures. In their meta-analysis, Shand et al. [17] found a small and positive relation between PTSD and post-traumatic growth in cancer patients (i.e. $r = 0.13$). We followed the rationale of Kashdan and Kane [21] in that unwillingness to be in contact with distressing thoughts and feelings—i.e. experiential avoidance—would moderate the relation between Post-Traumatic Stress Disorder (PTSD) and growth. Thus, among patients who reported high experiential avoidance prior to HSCT, there should be no association between PTSD and psychological growth at the 5-month follow-up. This association should appear only in patients with low experiential avoidance.

**Methods**

**Participants.**

The study protocol was presented to 275 patients. Of these, 236 signed the informed consent and entered in the “psygreffe” cohort. Of these, 187 completed the first questionnaire ($M_{age} = 52.07, SD = 13.22$, ranging from 19 to 72 years old), 157 filled out the second questionnaire, and 91 filled out the third questionnaire. Between the first and the third questionnaire, 30 participants died. In addition, 67 participants left the study various reasons (e.g. fatigue, lack of motivation, etc.). Patients came from three hospital centers of Paris, Nancy and Clermont-Ferrand in France. 41.9% of participants were female. In total, 65.7% were married, 46.3% had an educational level beyond the license degree and 22.5% belonged to the upper-professional category. 17% had myelodysplastic syndrome, 10.4% had myeloproliferative neoplasia, and 35.7% were candidates for an allograft for acute leukemia. 94% were having their first transplant. The ethical committee Sud-Est III (IRB 2017-026 B) approved the study. Informed written consent was obtained from each participant. The data that support the findings of this study are openly available in figshare at https://doi.org/10.6084/m9.figshare.12382916.v2

**Procedure.**

All participants were informed of the study during the pre-graft interview and read an information note. They had 15 days to decide whether they would participate or not. Then, they filled out an informed consent form and completed a first questionnaire assessing mental health (i.e. anxiety, depression and happiness), psychological dispositions (i.e. optimism, extraversion, experiential avoidance, acceptance, and dispositional mindfulness) and sociodemographic variables, 20 days ($mean = 19.6$) before their hospitalization for an allograft (Time 0). All scales used were previously validated measures. A second questionnaire was given at the start of hospitalization and had to be completed during the first week from the day after the allograft intervention (Time 1). This second questionnaire evaluated five dimensions of post-traumatic growth to constitute the measure of actual growth. Finally, participants were invited to complete a third questionnaire at five months after their entrance to hospital during a follow-up date.
This third questionnaire measured the same five domains of growth that constitute the measure of actual growth, a scale of perceived growth (PTGI) and a measure of Post-Traumatic Stress Disorder (PTSD). The relevant medical data were extracted from the ProMISe (Project Manager Internet Server).

**Measures.**

**Post-Traumatic Growth (PTG) Assessment.**

**Perceived Post-Traumatic Growth.** To assess perceived change from pre- to post-trauma, participants were asked to complete the Post Traumatic Growth Inventory (PTGI) [22] five months after the HSCT with regard to the transplant they had experienced. This scale measures post-traumatic growth across 21 items. Individuals are asked to indicate on a scale ranging from 0 (“I did not experience this change”) to 5 (“I experienced this change significantly”) how much they experienced and lived a change in their life since HSCT. The total score is calculated by adding up each of the items. The internal consistency of the scale in our study is very satisfactory ($\alpha = 0.96$). The PTGI measures five areas of growth: (1) relating to others ($\alpha = 0.89$), (2) new possibilities ($\alpha = 0.90$), (3) personal strength ($\alpha = 0.86$), (4) spirituality change ($\alpha = 0.78$), and (5) appreciation of life ($\alpha = 0.85$).

**Actual Post-Traumatic Growth on Measures of PTG dimensions.** To assess actual change from pre- to post-trauma, at both Time 1 and Time 2, we asked participants to complete several scales that corresponded to the dimensions of growth assessed by the PTGI. We examined whether the domain measures we chose assessed similar general constructs as the PTGI by correlating scores on the PTGI at Time 2 with scores on the five dimensions measured independently at Time 2. The first dimension, “relating to others” was assessed using the 13-item Positive Orientation to Others dimension from the Goal and Mode Value Inventories [23]; $a_1 = 0.92; a_2 = 0.93$). The correlation with “relating to others” (PTGI) was 0.41 ($p < 0.001$). The second dimension, namely “new possibilities”, was assessed with the Personal Growth subscale (14 items) from Ryff and Essex’s Psychological Well Being (PWB) scale [24] (e.g., “I think it is important to have new experiences that challenge how you think about yourself and the world”; $a_1 = 0.79; a_2 = 0.79$). The correlation between this measure and the new possibilities dimension of PTGI was 0.28 ($p < 0.01$). The third domain, “personal strength”, was measured using the 24-item Brief Strengths Test, which is a brief version of the “values in action inventory of strengths” (VIAIS) [25]. The 24-item scale had a satisfactory internal consistency ($a_1 = 0.86; a_2 = 0.92$) and correlated positively with the “personal strength” dimension of the PTGI ($r = 0.29, p < 0.01$). The 24 personal strengths are grouped into six virtues (wisdom and knowledge, courage, humanity, justice, temperance, transcendence). The fourth dimension, “change in spirituality”, was assessed using the 6-item Intrinsic Spirituality scale of Hodge [26]; $a_1 = 0.96; a_2 = 0.97$). This scale correlated strongly with the “spirituality change” dimension of the PTGI ($r = 0.60, p < 0.001$). Finally, “appreciation of life”, the fifth domain, was measured using the 5-item Satisfaction with Life Scale developed by Diener et al. [27]; $a_1 = 0.91; a_2 = 0.85$). Unexpectedly, and contrary to Frazier et al. [11], this scale was not related significantly to the appreciation of life component from the PTGI ($r = 0.12, p > 0.25$) A composite score of actual PTG at Time 1 was computed by averaging the five dimensions at Time 1, and a composite score of actual PTG at Time 2 was computed by
averaging the five dimensions at Time 2. At Time 2, this composite score was positively and significantly related with PTGI (\(r = 0.42, p<0.001\)). A score of actual change in growth was calculated by subtracting the average score of actual growth at Time 1 from the average score of actual growth at Time 2.

**Mental Health and Psychological Disposition Prior to Hospitalization.**

*Mental Health.* We assessed anxiety, depression and happiness. Anxiety and Depression symptomatology was measured with the Hospital Anxiety and Depression scale (HADs) [28]. Seven items estimated anxiety symptomatology (\(\alpha_{t0} = 0.76; \alpha_{t2} = 0.72\)) and seven items assessed symptoms of depression (\(\alpha_{t0} = 0.70; \alpha_{t2} = 0.80\)). Happiness was assessed with the Subjective Authentic-Durable Happiness scale (SA-DHS) [29] (\(\alpha_{t0} = 0.96; \alpha_{t2} = 0.97\)).

*Psychological Dispositions.* While optimism was measured using the Life Orientation Test- revised (LOT-R; \(\alpha = 0.76\)) [30], extraversion was assessed using the Big Five Inventory (BFI; \(\alpha = 0.84\)) [31]. Experiential avoidance was measured with the Avoidance and Fusion Questionnaire for Adult (AFQ; \(\alpha = 0.88\)) [32], and acceptance was assessed with the Acceptance and Action Questionnaire II (AAQ II; \(\alpha = 0.81\)) [33]. Dispositional mindfulness was assessed with the FFMQ [34] (\(\alpha = 0.87\)). This scale comprises five dimensions: observing, describing, acting with awareness, nonjudging, and nonreactivity to the experience.

*PTSD Assessment at Follow-up.* The Post-Traumatic Stress Disorder Checklist Scale (PCLS) [35] was used to detect some symptoms of post-traumatic stress disorder through 17 items assessing the severity of 17 symptoms of PTSD listed in the DSM-IV. This scale had an adequate internal consistency (\(\alpha = 0.91\)).

**Statistical Analyses.**

Concerning the actual growth, we compared the scores obtained at the 5-month follow-up with the scores assessed before HSCT. For each comparison, we reported the p-value and BF\(_{10}\) (i.e. the extent to which the data support H1). Substantial support for H\(_1\) was provided by a BF > 3 (BF > 10 was judged strong; > 30 very strong and > 100 decisive). Support for H\(_0\) was provided by a BF < 1. The reliable change index (RCI) was computed for each dimension of actual growth [36]. All relations between variables were assessed using Pearson \(r\). Finally, we tested the Moderating Effect of Experiential Avoidance on the Relationship between Post-Traumatic Stress Disorder (PTSD) and Perceived/Actual Growth using a moderation analysis. First, we centered all the variables on the grand mean. Then, using Process Version 3.4.1. for SPSS, we performed a moderation analysis (Bootstrap: 5000 samples) with PTSD as the independent variable, experiential avoidance as a moderator, and the measures of perceived growth as a dependent variable (DV).

**Results**

**Perceived and Actual Growth.**
Table 1 presents descriptive data. Four of the five dimensions we measured showed a significant decrease between before and after transplantation (i.e. positive orientation, personal strengths, spirituality and life satisfaction). Bayesian factors also provided clear support for the hypothesis of a decrease following HSCT for these four measures. The only dimension that did not vary significantly with time was the personal growth subscale from the psychological well-being scale [24]. The reliable change index (RCI) was computed for each dimension [36]. The percentage of reliable decrease was always superior to the percentage of reliable increase. The RCI for the mean score of actual change in growth indicated a reliable increase for 5.6% of patients and a reliable decrease for 40.8% of patients.
Table 1
Descriptive Data of Perceived and Actual Post-Traumatic Growth.

|                                | Mean before HSCT | Mean at 5-month follow-up | Change score | Cohen's $d$ | BF$_{10}$ | Reliable increase | Reliable decrease |
|--------------------------------|------------------|---------------------------|--------------|-------------|-----------|-------------------|-------------------|
| **Perceived Growth (PTGI)**    |                  |                           |              |             |           |                   |                   |
| - Relating to others           |                  | 2.90                      |              |             |           |                   |                   |
| - New Possibilities            |                  | 2.30                      |              |             |           |                   |                   |
| - Personal strength            |                  | 2.84                      |              |             |           |                   |                   |
| - Change in spirituality       |                  | 1.84                      |              |             |           |                   |                   |
| - Appreciation of life         |                  | 3.23                      |              |             |           |                   |                   |
| Mean score of PTGI             |                  | 2.67                      |              |             |           |                   |                   |
| **Actual Growth**              |                  |                           |              |             |           |                   |                   |
| - Positive orientation to others | 5.81             | 5.35                      | -0.46***     | -0.45       | 65        | 8.5%              | 33.8%             |
| - Personal Growth subscale     | 4.67             | 4.53                      | -0.14*       | -0.24       | 0.9       | 11.4%             | 28.6%             |
| - Brief Strengths Inventory    | 3.86             | 3.70                      | -0.16**      | -0.36       | 7.8       | 10.0%             | 28.6%             |
| Wisdom/knowledge               | 3.87             | 3.70                      | -0.17**      | -0.32       | 3.3       | 7.1%              | 25.7%             |
| Courage                        | 3.85             | 3.79                      | -0.06        | -0.12       | 0.2       | 10.3%             | 10.3%             |
| Humanity                       | 4.03             | 3.84                      | -0.19*       | -0.31       | 2.5       | 10.3%             | 27.9%             |
| Justice                        | 3.96             | 3.62                      | -0.34***     | -0.43       | 31.9      | 2.9%              | 16.2%             |
| Temperance                     | 3.59             | 3.48                      | -0.11        | -0.15       | 0.2       | 8.8%              | 10.3%             |
| Transcendence                  | 3.92             | 3.76                      | -0.16*       | -0.24       | 0.9       | 8.8%              | 17.6%             |
| - Intrinsic Spirituality scale | 4.80             | 4.16                      | -0.64**      | -0.35       | 6.7       | 17.4%             | 43.5%             |
| - Life satisfaction scale      | 5.40             | 4.92                      | -0.48***     | -0.44       | 52.8      | 8.6%              | 32.9%             |
| Mean score in actual growth    | 4.90             | 4.52                      | -0.38***     | -0.68       | >150      | 5.6%              | 40.8%             |

*Note:* *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. 
Relationship between Measures of Perceived and Actual Change in Growth.

The mean score of actual change in growth (actual growth at Time 2 – actual growth at Time 1) was significantly and weakly related to the mean score of PTGI assessed at Time 2 ($r = 0.25$, $p < 0.036$). As Table 2 shows, of the five dimensions in perceived and actual growth assessed, two dimensions were significantly correlated (i.e. personal strengths and appreciation/satisfaction with life) and three domains were not significantly correlated (i.e. relating/positive orientation to others, new possibilities/personal growth subscale, and spirituality).

Table 2
Pearson Correlations Between Perceived Growth (PTGI) and Actual Change in Growth.

| Actual Change in Growth (T2 – T1) | Positive orientation to others | Personal Growth subscale | Brief Strengths Inventory | Intrinsic Spirituality scale | Life satisfaction scale |
|----------------------------------|--------------------------------|--------------------------|----------------------------|-----------------------------|------------------------|
| Perceived Growth at Time 2 (PTGI) |                                |                          |                            |                             |                        |
| Relating to Others              | 0.17                           | 0.12                     | 0.29*                      | 0.20+                       | 0.10                   |
| New Possibilities               | 0.15                           | 0.16                     | 0.29*                      | 0.03                        | 0.17                   |
| Personal Strength               | 0.15                           | 0.03                     | 0.29*                      | 0.07                        | 0.17                   |
| Spiritual Change                | 0.12                           | 0.26*                    | 0.03                       | -0.01                       | 0.09                   |
| Appreciation of life            | 0.19                           | 0.04                     | 0.29*                      | -0.05                       | 0.25*                  |
| Mean score of PTGI              | 0.18                           | 0.13                     | 0.29*                      | 0.08                        | 0.18                   |

Note: * $p < 0.05$, + $p < 0.10$.

Relationship between Perceived and Actual Growth, and Mental Health and Psychological Dispositions.

Table 3 presents the Pearson correlations between the measures of growth and those of mental health and psychological dispositions. Concerning mental health, while happiness prior to hospitalization significantly predicted and positively perceived growth ($r = 0.36$, $p < 0.001$), actual change in growth was not significantly related to happiness ($r = 0.14$). Thus, the happiest patients prior to hospitalization were those who perceived greater growth at the follow-up.
Table 3
Prospective Effects of Mental Health and Positive Psychological Disposition Prior to Hospitalization for HSCT (Time 0) on Perceived Growth (PTGI) at Time 2, and Actual Change in Growth Between Time 1 and Time 2 (Pearson Correlations).

|                                | Anxiety (HAD-A) | Depression (HAD-D) | Happiness (SA-DHS) | Optimism (LOT) | Extraversion (BFI) | Acceptance (AAQII) |
|--------------------------------|-----------------|--------------------|--------------------|----------------|-------------------|--------------------|
| **Perceived Growth at Time 2 (PTGI)** |                 |                    |                    |                |                   |                    |
| Relating to Others             | -0.05           | -0.11              | 0.42***            | 0.30**         | 0.22+             | 0.15               |
| New Possibilities              | 0.17            | 0.09               | 0.23*              | -0.01          | 0.18              | -0.06              |
| Personal Strength              | -0.06           | -0.10              | 0.35***            | 0.13           | 0.23*             | 0.10               |
| Spiritual Change               | -0.01           | -0.07              | 0.23*              | 0.13           | 0.19              | -0.02              |
| Appreciation of life           | 0.05            | -0.06              | 0.26*              | 0.15           | 0.32**            | 0.09               |
| **Mean score of PTGI**         | 0.03            | -0.05              | 0.36***            | 0.17           | 0.25*             | 0.06               |
| **Actual Change in Growth (Time 2 – Time 1)** |                 |                    |                    |                |                   |                    |
| Positive orientation to others | -0.17           | -0.29*             | 0.21               | 0.03           | 0.24+             | 0.22+              |
| Personal Growth subscale       | 0.38**          | 0.20               | -0.23+             | -0.28*         | -0.06             | -0.09              |
| Brief Strengths Inventory      | -0.13           | -0.20              | 0.16               | 0.20           | 0.26*             | 0.50*              |
| Intrinsic Spirituality scale   | -0.07           | -0.20              | 0.11               | 0.15           | -0.18             | 0.24+              |
| Life satisfaction scale        | -0.19           | 0.03               | 0.02               | 0.02           | 0.07              | 0.21               |
| **Mean score in actual growth change** | -0.14           | -0.20              | 0.14               | 0.11           | 0.04              | 0.39**             |

**Note:** *** p < 0.001, ** p < 0.01, * p < 0.05, + p < 0.10.

Extraversion prior to hospitalization ($r = 0.25$, $p < 0.05$), but not optimism and acceptance (respectively, $r = 0.17$ and $r = 0.06$, $ps > 0.10$), was found to significantly and positively predict the PTGI. This was not the case with actual change in growth which was positively and significantly related only with acceptance ($r = 0.39$, $p < 0.01$). Thus, the most extraverted patients prior to hospitalization were those who reported the highest level of PTGI at the follow-up, and those who scored higher on the acceptance scale, prior to
hospitalization, benefited the most in terms of actual growth between transplantation and the 5-month follow-up. Concerning dispositional mindfulness (see Table 4), observing and describing were significantly and positively related to perceived growth (respectively, $r = 0.32$ and $r = 0.34$, $p < 0.01$), but not to actual growth (respectively, $r = 0.16$ and $r = 0.23$, $p > 0.05$). The nonjudgment facet was negatively and significantly related to perceived growth ($r = -0.24$, $p < 0.05$) and positively and significantly related to actual change ($r = 0.28$, $p < 0.05$). The latter was positively and marginally related to non-reacting ($r = 0.24$, $p < 0.06$), which was not the case with perceived growth ($r = 0.06$).

Table 4
Prospective Effects of Five Facets of Mindfulness Prior to Hospitalization for HSCT (Time 0) on Perceived Growth (PTGI) at Time 2, and Actual Change in Growth Between Time 1 and Time 2 (Pearson Correlations).

| Five Facets Mindfulness Questionnaire (FFMQ) | Observing | Describing | Acting with awareness | Non-reacting | Non-judging |
|---------------------------------------------|-----------|------------|-----------------------|--------------|-------------|
| **Perceived Growth at Time 2 (PTGI)**       |           |            |                       |              |             |
| Relating to Others                          | 0.30**    | 0.33**     | 0.13                  | 0.16         | -0.11       |
| New Possibilities                           | 0.28*     | 0.27*      | 0.08                  | -0.04        | -0.26*      |
| Personal Strength                           | 0.24*     | 0.28*      | 0.21+                 | 0.02         | -0.17       |
| Spiritual Change                            | 0.30**    | 0.22+      | 0.05                  | 0.08         | -0.21+      |
| Appreciation of life                        | 0.30**    | 0.37***    | 0.26*                 | 0.01         | -0.29*      |
| Total score                                 | 0.32**    | 0.34**     | 0.16                  | 0.06         | -0.24*      |
| **Actual Change in Growth (Time 2 – Time 1)** |           |            |                       |              |             |
| Positive orientation to others              | 0.21      | 0.19       | 0.22                  | 0.26*        | 0.09        |
| Personal Growth subscale                    | 0.05      | 0.11       | -0.15                 | 0.04         | 0.14        |
| Brief Strengths Inventory                   | 0.31*     | 0.29*      | 0.19                  | 0.18         | 0.23+       |
| Intrinsic Spirituality scale                | -0.06     | 0.01       | 0.14                  | 0.17         | 0.24+       |
| Life satisfaction scale                     | 0.15      | 0.17       | 0.12                  | -0.03        | 0.05        |
| Mean score in actual growth change          | 0.16      | 0.23+      | 0.23+                 | 0.24+        | 0.28*       |

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, + $p < 0.10$.  

Test of the Moderating Effect of Experiential Avoidance on the Relationship between Post-Traumatic Stress Disorder (PTSD) and Perceived/Actual Growth
We performed a moderation analysis with PTSD as the independent variable, experiential avoidance as a moderator, and the measures of perceived growth as a dependent variable (DV). While PTSD was marginally and positively related with perceived growth (b = 0.02, SE = 0.01, p < 0.06), experiential avoidance was not related to PTGI (b = 0.14, SE = 0.22, p > 0.50). We found support for a PTSD x experiential avoidance interaction effect in predicting perceived post-traumatic growth (PTGI; b = -0.03, SE = 0.01, p < 0.038). Conditioned at 1 SD below the mean on experiential avoidance, PTSD was positively related to PTGI (b = 0.04, SE = 0.02, p < 0.02), whereas when conditioned at 1 SD above the mean on experiential avoidance, PTSD was not related to PTGI (b = 0.01, SE = 0.01, p > 0.70). Thus, in the absence of experiential avoidance, PTSD was associated with greater perceived growth. This was not the case in the presence of experiential avoidance. Finally, we computed a similar moderation analysis with the mean score of actual change in growth as a DV. Neither PTSD nor experiential avoidance were related to actual growth (all ps > 0.10). We did not find support for a PTSD x experiential avoidance interaction effect (b = -0.01, SE = 0.01, p > 0.45).

Discussion

Focusing on post-traumatic growth among patients who have received an allograft, the main purpose of this study was to highlight the illusory or genuine side of self-reported post-traumatic growth. In order to address this question, we compared scores on perceived post-traumatic growth, assessed by the Post-Traumatic Growth Inventory (PTGI) [8], and changes in scores of actual post-traumatic growth measured at two times (during the first week after transplantation and five months later) and corresponding to the five domains of PTGI. This research also aimed to highlight respective relationships between perceived post-traumatic growth, actual growth and both mental health and psychological dispositions, with a special investigation on dispositional mindfulness facets and experiential avoidance as a moderator between PTSD symptomatology and actual/perceived growth.

Firstly, results seem to more support the hypothesis of decline rather than growth five months after HSCT. These findings are consistent with the study of Frazier et al. [11], who found that post-traumatic growth is not as common as previously shown in numerous studies and can be a skewed perception of positive changes. More specifically, assessment instruments of post-traumatic growth, such as the PTGI—the most commonly used instrument to assess growth following an adverse event [14]—are not suitable to reveal a genuine decline or increase of growth. This suggests there is a need to develop more reliable instruments of post-traumatic growth [37] and conduct more systematic, longitudinal protocols, as recommended by Infurna and Jayawickreme [12]. In addition, the results of this study clearly raise questions about the specificities of the allograft process. Indeed, as highlighted by Sumalla et al. [16], research on post-traumatic growth should consider the substantial differences existing between the traumatic nature of cancer and an acute trauma, leading consequently to different health outcomes. For example, contrary to an acute stress, the temporal delimitation of the traumatic event in the case of cancer is not as perceptible or delimited for various reasons such as the risk of relapse. These differences have major implications on the lived experiences of patients who have to face an ongoing threat, which often engenders psychological distress. This observation is particularly true in the case of HSCT since
patients are constantly confronted with the risk of relapse, infections and graft versus host disease (GvHD) in the long-term. So, a decline in actual psychological growth could reflect the specificities of such treatments. It would be relevant to realize a follow-up several years after HSCT to determine whether patients present a complete or a partial psychological recovery [38].

Other findings revealed by this study include the weak correlation between perceived post-traumatic growth and actual growth, and the fact that they have different psychological correlates [9, 11]. If perceived growth is mainly related to positive thoughts and feelings such as happiness [17] and a personality trait (i.e. extraversion; [39]), the actual growth is, however, only predicted by a characteristic of psychological flexibility, namely acceptance. The nature of psychological correlates of perceived growth tends to support the interpretation of Infurna and Jayawickreme [12] who suggest that PTGI may reflect reality distortions, selective appraisals, coping, and personality characteristics. However, the prospective effect of acceptance on actual growth suggests the need to target preventively this dimension of psychological flexibility to alleviate psychological distress and enhance actual psychological growth among patients confronted to stressful events such as cancer [19] and HSCT.

Concerning dispositional mindfulness, with the exception of non-judging, most facets (i.e. observing, describing, acting with awareness, non-judging) did not robustly predict actual growth. This is not the case for perceived growth, which is positively predicted by the observing and describing facets, whereas the non-judging dimension is negatively related to perceived growth. These results seem to confirm that perceived growth is linked to a cognitive activity of interpreting lived experience that involves observing, describing and judging one's inner experience, while actual growth is more related to decentering (here to non-judging) and acceptance processes.

The assumption made about the moderating effect of experiential avoidance on the relationship between PTSD symptomatology and both perceived and actual growth confirms the study of Kashdan and Kane [21] for perceived growth only. For actual growth, this confirms the meta-analysis of Mangelsdorf et al. [13], who concluded that there is “no general evidence for the widespread conviction that negative life events have a stronger effect than positive ones”. Therefore, the direct confrontation with the source of distress does not allow for actual growth, it is rather its acceptance and lack of over-judging that seems important. On the other hand, as for Kashdan and Kane [21], this direct confrontation seems to be associated with perceived growth. This may once again depict the interpretive activity of lived experience. Those who are in experiential avoidance do not interpret and do not positively re-evaluate their experiences. Consistently, research has revealed that experiential avoidance and avoidant coping are overlapping despite their independent contribution to explain psychological distress and well-being [40]. Avoidant coping is negatively related with positive re-appraisal coping [41], the latter being involved in perceived growth [11].

**Study Limitations.**

This study has several limitations. First, the sample in the 5-month follow-up is reduced by half compared to the baseline (pre-hospitalization) sample. This study should be replicated with a larger cohort at
baseline. This seems all the more important since the addition of a longer follow-up would be necessary. Finally, the participants were quite well-educated and mainly of French nationality. Therefore, the findings cannot be generalized.

*Clinical Implications.*

This study highlights the importance of better understanding the factors associated with psychological decline following HSTC. Therefore, it seems particularly relevant to identify post-HSTC difficulties that inhibit growth in order to remedy them. Acceptance and non-judging emerged as significant predictors of actual growth following transplantation. Thus, targeting these variables using tools from the third wave of cognitive-behavioral therapy, such as Mindfulness-Based Stress Reduction (MBSR) for non-judging and ACT for acceptance, should be beneficial for patients' lives after HSCT.

**Conclusion**

To conclude on the main results extracted from this study, we can observe, in the case of HSCT, a decline at 5 months in actual growth, which suggests that a substantial portion of patients experience difficulties in their psychological state even a few months after the intervention. The PTGI seems not suitable to reveal a genuine decline or increase of growth and raises doubts concerning studies based solely on this instrument. Despite the need for further studies with a more long-term follow-up to characterize the nature of changes lived by patients, the prospective effect of acceptance and non-judging on actual growth offers an interesting perspective in prevention.

**Abbreviations**

ACT = Acceptance and Commitment Therapy; GvHD = Graft versus Host Disease; HSCT = Hematopoietic Stem-Cell Transplantation; MBSR = Mindfulness-Based Stress Reduction; PTG = Post-Traumatic Growth; PTGI = Post-Traumatic Growth Inventory; PTSD = Post-Traumatic Stress Disorder; ProMISe = Project Manager Internet Server; RCI = Reliable Change Index.

**Declarations**

*Ethics approval and consent to participate:* The ethical committee CPP Sud-Est III, Groupement Hospitalier Est (IRB 2017-026 B) approved the study. Informed written consent was obtained from each participant.

*Consent for publication:* All authors consent for publication.

*Competing interests:* None.

*Funding:* None.
Authors' contributions: MC and MD designed the study, analyzed the data, and wrote the paper. IB, AC, MTR, JOB, RPDT and MC executed the study, collected the data and collaborated with the writing. RPDT collaborated with the design. All authors approved the final version of the manuscript for submission.

Acknowledgements: We would like to thank all the nursing staff and the clinical investigators (Frédérique Thomas Lallement & Tiana Andriamasy) of Saint-Louis Hospital, Nancy-Brabois Hospital and Estaing Hospital. We also thank promotor AGRAH and finally all the patients of EGMOS association.

Availability of the data and materials: The data that support the findings of this study are openly available in figshare at https://doi.org/10.6084/m9.figshare.12382916.v2

References

[1] Allart-Vorelli P, Porro B, Baguet F, Michel A, Cousson-Gélie, F. Haematological cancer and quality of life: a systematic literature review. Blood Cancer J 2015; 5(4) : 305.

[2] Linden W, Vodermaier A, MacKenzie R, Greig D. Anxiety and depression after cancer diagnosis: prevalence rates by cancer type, gender, and age. J Affect Disord 2012; 141(2-3): 343-51.

[3] Amler S, Sauerland MC, Deiters C, Büchner T, Schumacher A. Factors influencing life satisfaction in acute myeloid leukemia survivors following allogeneic stem cell transplantation: a cross-sectional study. Health Qual Life Outcomes 2015; 13(1): 28.

[4] Braamse AM, Gerrits MM, van Meijel B, Visser O, van Oppen P, Boenink AD, et al.. Predictors of health-related quality of life in patients treated with auto-and allo-SCT for hematological malignancies. Bone Marrow Transplant 2012; 47(6): 757-69.

[5] Mosher CE, Redd WH, Rini CM, Burkhalter JE, DuHamel KN. Physical, psychological, and social sequelae following hematopoietic stem cell transplantation: a review of the literature. Psychoonconlogy 2009; 18(2): 113-27.

[6] Affleck G, Tennen H. Construing benefits from adversity: Adaptational significance and dispositional underpinnings. J Pers 1996; 64(4): 899-922.

[7] Davis, C. G., Nolen-Hoeksema, S., & Larson, J. Making sense of loss and benefiting from the experience: Two construals of meaning. J Pers Soc Psychol 1998; 75: 561–74.

[8] Tedeschi RG, Calhoun LG. " Posttraumatic growth: Conceptual foundations and empirical evidence". Psychol Inq 2004; 15(1): 1-18.

[9] Boals A, Schuler K. Shattered cell phones, but not shattered lives: A comparison of reports of illusory posttraumatic growth on the Posttraumatic Growth Inventory and the Stress-Related Growth Scale—Revised. Psychol Trauma 2019; 11(2): 239.
[10] Coyne, J. C., & Tennen, H. Positive psychology in cancer care: Bad science, exaggerated claims, and unproven medicine. Ann Behav Med 2010; 39(1): 16-26.

[11] Frazier P, Tennen H, Gavian M, Park C, Tomich P, Tashiro T. Does self-reported posttraumatic growth reflect genuine positive change? Psychol Sci 2009; 20(7): 912-19.

[12] Infurna FJ, Jayawickreme E. Fixing the growth illusion: New directions for research in resilience and posttraumatic growth. Curr Dir Psychol Sci 2019; 28(2): 152-58.

[13] Mangelsdorf J, Eid M, Luhmann M. Does growth require suffering? A systematic review and meta-analysis on genuine posttraumatic and postecstatic growth. Psychol Bull 2019; 145(3): 302.

[14] Jayawickreme E, Rivers J, Rauthmann JM. Do we know how adversity impacts human development? Res Hum Dev 2018; 15(3-4): 294-316.

[15] Zoellner T, Maercker A. Posttraumatic growth in clinical psychology—A critical review and introduction of a two component model. Clin Psychol Rev 2006; 26(5): 626-53.

[16] Sumalla EC, Ochoa C, Blanco I. Posttraumatic growth in cancer: reality or illusion?. Clin Psychol Rev 2009; 29(1): 24-33.

[17] Shand LK, Cowlishaw S, Brooker JE, Burney S, Ricciardelli LA. Correlates of post-traumatic stress symptoms and growth in cancer patients: A systematic review and meta-analysis. Psychooncology 2015; 24(6): 624-34.

[18] Garland, E. L., Thielking, P., Thomas, E. A., Coombs, M., White, S., Lombardi, J., & Beck, A. Linking dispositional mindfulness and positive psychological processes in cancer survivorship: a multivariate path analytic test of the mindfulness-to-meaning theory. Psychooncology 2017; 26(5): 686-92.

[19] Secinti E, Tometich DB, Johns SA, Mosher CE. The relationship between acceptance of cancer and distress: A meta-analytic review. Clin Psychol Rev 2019; 71: 27-38.

[20] Larson AG, Morris KJ, Juckett MB, Coe CL, Broman AT, Costanzo ES. Mindfulness, experiential avoidance, and recovery from hematopoietic stem cell transplantation. Ann Behav Med 2019; 53(10): 886-95.

[21] Kashdan TB, Kane JQ. Post-traumatic distress and the presence of post-traumatic growth and meaning in life: Experiential avoidance as a moderator. Pers Individ Dif 2011; 50(1): 84-9.

[22] Tedeschi RG, Calhoun LG. The Posttraumatic Growth Inventory: Measuring the positive legacy of trauma. J Trauma Stress 1996; 9(3): 455-71.

[23] Braithwaite VA, Law HG. Structure of human values: Testing the adequacy of the Rokeach Value Survey. J Pers Soc Psychol 1985; 49(1): 250.
[24] Ryff CD, Essex MJ. The interpretation of life experience and well-being: The sample case of relocation. Psychol Aging 1992; 7(4): 507.

[25] McGrath, R. E. Technical report: The VIA Assessment Suite for Adults: Development and evaluation. Cincinnati, OH: VIA Institute on Character; 2017.

[26] Hodge DR. The intrinsic spirituality scale: A new six-item instrument for assessing the salience of spirituality as a motivational construct. J Soc Serv Res 2003; 30(1): 41-61.

[27] Diener ED, Emmons RA, Larsen RJ, Griffin S. The satisfaction with life scale. J Pers Assess 1985; 49(1): 71-5.

[28] Zigmond AS, Snaith RP. The hospital anxiety and depression scale. Acta Psychiatr Scand 1983; 67(6): 361-70.

[29] Dambrun M, Desprès G, Lac G. Measuring happiness: from fluctuating happiness to authentic–durable happiness. Front Psychol 2012; 3: 16.

[30] Scheier MF, Carver CS, Bridges MW. Distinguishing optimism from neuroticism (and trait anxiety, self-mastery, and self-esteem): a reevaluation of the Life Orientation Test. J Pers Soc Psychol 1994; 67(6): 1063.

[31] John OP, Srivastava S. The Big Five trait taxonomy: History, measurement, and theoretical perspectives. Handbook of personality: Theory and research 1999; 2: 102-38.

[32] Fergus TA, Valentiner DP, Gillen MJ, Hiraoka R, Twohig MP, Abramowitz, et al. Assessing psychological inflexibility: The psychometric properties of the Avoidance and Fusion Questionnaire for Youth in two adult samples. Psychol Assess 2012; 24(2): 402.

[33] Bond FW, Hayes SC, Baer RA, Carpenter KM, Guenole N, Orcutt HK, et al. Preliminary psychometric properties of the Acceptance and Action Questionnaire–II: A revised measure of psychological inflexibility and experiential avoidance. Behav Ther 2011; 42(4): 676-88.

[34] Baer RA, Smith GT, Hopkins J, Krietemeyer J, Toney L. Using self-report assessment methods to explore facets of mindfulness. Assessment 2006; 13(1): 27-45.

[35] Weathers FW, Litz BT, Herman DS, Huska JA, Keane TM. The PTSD Checklist (PCL): Reliability, validity, and diagnostic utility. In annual convention of the international society for traumatic stress studies, San Antonio, TX; 1993.

[36] Jacobson NS, Truax P. Clinical significance: a statistical approach to defining meaningful change in psychotherapy research. J Consult Clin Psychol 1992; 59 (1): 12-19.
[37] Boals A, Schuler KL. Reducing reports of illusory posttraumatic growth: A revised version of the Stress-Related Growth Scale (SRGS-R). Psychol Trauma 2018; 10(2): 190.

[38] Diener, E., Lucas, R. E., & Scollon, C. N. Beyond the hedonic treadmill: Revising the adaptation theory of well-being. Am Psychol 2006; 61(4): 305–314. https://doi.org/10.1037/0003-066X.61.4.305

[39] Tedeschi, R. G., & Calhoun, L. G. The Posttraumatic Growth Inventory: Measuring the positive legacy of trauma. J Trauma Stress 1996; 9(3): 455-471.

[40] Karekla M, Panayiotou G. (2011). Coping and experiential avoidance: Unique or overlapping constructs?. J Behav Ther Exp Psychiatry 2011 ; 42(2) : 163-170.

[41] Kvillemo P, Bränström R. Coping with breast cancer: a meta-analysis. PLoS One 2014; 9(11). DOI: 10.1371/journal.pone.011273.