RESEARCH ARTICLE

Specific event-related data presentation changes embitterment affect - an experimental study

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Abstract
Background: During the corona pandemic increased rates of embitterment have been found in the general population. As embitterment occurs reactive to triggers related to experienced negative events, and as people were steadily exposed to pandemic-related information, the research question arises: Can embitterment be triggered by pandemic-related information in form of infection rates displayed in figures?
Method: Within an experimental design we investigated whether a figure presenting infection rates in an aggravated manner (seemingly strong infection increase and then stable course, experimental group, EG, n=138) leads to stronger embitterment increase, as compared to a figure presenting infection rates seemingly stable (control group, CG, n=155). Accompanying characteristics with potential influence on embitterment have been assessed: wisdom, general belief in a just world, perceived injustice events during the pandemic.
Results: In contrast to the experimental hypothesis, the EG decreased in embitterment after reading the aggravated infection rates figure, significantly more than the CG. People with higher wisdom scores had a lower embitterment level after watching the infection data. There was no association between perceived pandemic-related injustice events and embitterment after watching the infection data. Belief in a just world slightly decreased over the course in both groups.
Discussion: By means of pandemic-related data presentation, embitterment affect can be changed. Contradictory to expectation, especially the aggravated presentation led to a reduction of embitterment. This example shows that even simple but specific information presentations can induce changes in state affect, and this happens independently from other relevant characteristics (such as perceived injustice events during pandemic, or general belief in a just world).
Professionals who present event-related data in public should explain these data and be aware that information and data presentation may impact on peoples affects.

Key words: embitterment, belief in a just world, emotion induction, information, pandemic, corona, Covid-19

1. Introduction

1.1 Embitterment

Embitterment is an affect known by everyone. It occurs when people are humiliated, their basic beliefs are hurt, due to injustice or being degraded[1,2,3]. This can occur in any life domain, such as in the context of job loss, divorce from a partnership, being betrayed by a friend, unfair resources distribution, societal injustice, or many other stressful - but normal - life events. Embitterment is a natural emotion, and a dimensional phenomenon. But, in case it becomes very strong and enduring, it may even reach illness level (posttraumatic embitterment disorder, PTED).[1] Embitterment reactions are coming along with impairments in life and work participation, and negative perception of different domains of one´s own life and the world, e.g. perception of social exclusion.[4]

In contexts of crisis, when there is much uncertainty, irregularities or injustices, increased rates of embitterment have been observed.[2,5] During the pandemic, there has been uncertainty and anxiety especially in the first months.[6] Uncertainty decreased when measures for protection (antigen tests, vaccination) were developed. But there was not only uncertainty, but several sources of injustice over the course of the pandemic. For example, there were different regulations for protective measures, which had hard economic side effects along with unknown positive effects. People followed the rules and got vaccinated, in order to re-achieve freedom, but policy continued implemented controlling and restriction rules. Therefore, increased embitterment during the corona pandemic has been expected[3] and observed: In December 2020 (after nine months of the pandemic), 16% of a German general population sample reported relevant degrees of embitterment, as compared to 3% before the pandemic, in 2019.[5]

1.2 Impact of information on embitterment reactions

Which important context factors have been there which might have contributed to development of embitterment? A context factor which was steadily present during the pandemic is ***information***, i. e. what is reported in the media and daily news. During the pandemic there was continued reporting of data and partly contradictory facts and expert positions.[7] Especially infection numbers were reported every day in the state television, but due to changing contexts (rate of testing, changes in the virus) they were hardly interpretable. This reporting of infection data became a symbol of the load of the pandemic problem. Beside the informative and risk communication purpose, such continuous reporting may steadily trigger people´s cognitive net of their pandemic experiences. This includes thoughts and feelings, events and injustices that happened to themselves, and how they have been let down. Being steadily exposed to the same seemingly unsolvable problems, even continued when uncertainty and risks decreased (by improved safety due to tests, vaccination) people may become angry and helpless over time, and, as a result, experience embitterment[5]. It has been found that texts about Covid-19 have the potential to increase negative emotions.[8] Beside text material, pictures and figures are also used to convey information, and should be considered in research.

As embitterment occurs reactive to triggers related to the experienced negative events, and as people were steadily exposed to pandemic-related information, the research question arises: Can embitterment be induced by pandemic-related information inform of infection rates displayed in figures?

Research until now shows that short information about historical issues, presented in a negative light, does not induce embitterment in persons who have not been not personally involved in the described situation.

For example, young people aged about 29 in the year 2020 were not negatively affected from a negative presentation of the Franco-German relationship up from the 1950er years.[9] But, in a presently ongoing pandemic, in which many people perceive some kind of injustices or political inconsistencies, infection rates might function as an embitterment trigger. Infection rates have been consistently reported in the daily news in Germany. They remind the people of the pandemic situation and its accompanying problems day by day. They are thus prone to trigger affects, such as anxiety,[10] but also embitterment[5]. As data on infection rates can be displayed ***neutrally*** descriptive, or rather with a certain reporting bias and ***aggravation*** (e.g. by stretched axis, to appear as a more dramatic increase), these two versions of data reporting are used in this present study. We randomly present one of two versions of corona infections rates, and afterwards assess the affective reaction of the persons.

1.3 Impact of personal coping capacities: wisdom and belief in a just world as protectors against embitterment

Although the context plays an important role for embitterment, this affect is not only due to the specific triggers and injustice events, but also depends on basic beliefs and coping skills of the person. In one same situation, e.g. after losing one´s job due to an injustice, one person may react embittered and another person does not. Obviously both persons cope differently with the situation. Two main coping mechanisms are of relevance against embitterment: wisdom and belief in a just world.

Wisdom is a complex capacity that has been identified as a coping mechanism and protector against embitterment. Wisdom can be described as the capacity to solve unsolvable problems, by choosing the fitting problem solving capacity for a specific challenging or ambiguous situation. Wisdom can be trained and is successfully used in the context of embitterment treatment.[11] In this present investigation wisdom is assessed as a potential predictor for lower embitterment after watching the corona infections figure.

Beside wisdom, ***belief in a just world***[12,13] must be considered in the context of embitterment reactions. Belief in a just world can on the one hand be hurt by an injustice or humiliation event, but on the other hand it might also be a protector against embitterment. An experiment gave hints that a strong belief in a just world was able to attenuate negative emotions such as anger and anxiety even when the subjects' focus was directed to the pandemic by reading a pandemic-related text.[8] Belief in a just world is a trait concept, but it is not clear whether a strong embitterment affect might come along with changes in belief in a just world. Thus, this should be observed within this present experiment.

1.4 Research question

Against this background, this present investigation aims to add evidence to the question of embitterment induction. By means of an experimental design we test whether a figure presenting Covid-19 infection rates in an aggravated manner (i.e. display of strong infection increase, experimental group, EG) leads to stronger embitterment reaction, as compared to a figure which presents infection rates neutrally (without strong infection increase, control group, CG). The experimental and explorative research questions are as follows:

1. Experimental question: Does embitterment increase stronger after watching aggravated infection data (EG), as compared to a neutral infection data presentation (CG)?
2. Experimental question: Does belief in a just world change in consequence of neutral (CG) or aggravated (EG) presentation of infection rates?
3. Explorative question: Are wisdom and belief in a just world associated with

increase or decrease of embitterment after being exposed to infection rates presentation?

4. Explorative question: Which domains of life are perceived as a burden, and which are perceived with satisfaction? Are there differences in perception of life burdens and satisfaction in people exposed to neutral (CG) and those exposed to aggravated (EG) infection rates presentation?

2. Methods

2.1 Procedure

Participants from a population of mostly young people before entering professional life were asked to participate in an online survey on "Mood, coping and life satisfaction during the corona pandemic". The introduction to the survey was written in a way to mask the experimental research question of this study, i. e. in which way information display may influence embitterment perception and life satisfaction. The survey was distributed via several online channels used by youngsters (facebook groups, academic mailing lists), and snowball system. Participants were first asked for socio-demographic data, followed by psychometric measures on their general belief in a just world (GBJW scale),[12,13] their individual perception of unjust events during the corona pandemic (whether any occurred, and if yes which type), embitterment (PTED scale),[1] and wisdom (12-WD-Scale).[14]

After this baseline assessment, the experimental manipulation followed. It was done in form of figure which shows the corona infections over a certain time. Either a neutral presentation was shown (control group, CG), or an aggravated presentation with streched y-axis, which optically implicate a high increase of infections (experimental group, EG). Immediately after, participants were asked how they felt after watching this figure from 1=very good to 7=very bad.

The figure and its affective evaluation were followed by the embitterment (PTED) scale again, and the scale of differential life burdens (DLB).[15]

Figure 1. Experimental plan

	Pre	**Manipulation (Figure displaying development of corona infections)**	**Post**
Experimental Group **EG**	Belief in a Just World (GBJW) Embitterment (PTED)	Graphical data presentation with manipulation in the sense of aggravation: a seemingly high increase of corona infection cases is presented	Belief in a Just World (GBJW) Embitterment (PTED)
Control Group **CG**	Wisdom (12-WD Scale)	Graphical data presentation without manipulation: a stable course of corona infections with few fluctuations over the time is presented	Differential Life Burden Scale (DLB)

2.2 Instruments

Belief in a Just World. The General Belief in a Just World Scale GBJW[12,13] is a self-report instrument to assess general belief in a just world. It contains six items, each on a six-point response scale ranging from 1 = not at all true to 6 = completely agree. An example item is "I think that the world is generally fair." Good homogeneity coefficients (Cronbach's alpha α) ranging from α = .56[16] to α = .83[17] have been reported. In this present investigation, Cronbach's alpha was α = .78. The convergent validity of the BJW scale with some other just-world measures found moderate to high correlations of the GBJW with other just-world measures ranging from r = .32 (BJW scale by Lipkus)[18] to r = .61 (BJW subscale of the World Assumption Scale of Janoff-Bulman).[19] The GBJW scale is discriminant valid against the personal BJW.[20]

Embitterment: PTED Scale. Embitterment was assessed using the nineteen-item PTED embitterment self-rating scale.[1] It starts with the statement "During the pandemic there was a severe and negative life event…," which is followed by answers such as "…that hurt my feelings and caused considerable embitterment," "…that triggers feelings of satisfaction when I think that the responsible party has to live through a similar situation," or "… that caused me to withdraw from friends and social activities." Ratings are made on a five-point Likert scale, from 0 = "not true at all" to 4 = "extremely true". The mean score of the PTED scale is used as a measure for the degree of embitterment. The PTED scale measures dimensional embitterment, i.e. it can be used independently of one specific event, but as a screening of the general embitterment load that the person perceived due to critical life events in recent months. A cut-off score (>=2.5 when scale ranges from 0-4) has been empirically defined to indicate high, i.e. clinically relevant, embitterment.[1] The PTED scale can be used for embitterment as a dimensional phenomenon, but not as a tool for

categorical diagnostic of an embitterment disorder. Until now, the PTED scale has been used internationally for measuring the level of embitterment, e. g. in general population samples or general clinical samples.[21,22] Cronbach's alpha of the PTED scale was α = .92 in this present study. We used >=2.5 as a cut-off to indicate clinically relevant embitterment.[1]

Wisdom. Wisdom is the ability to solve unsolvable life problems. The 12-WD-Scale[14] is a content validly conceptualized self-report questionnaire measuring 12 general wisdom-related attitudes, self-perception and self-attributions with twelve items. Each of the twelve statements stands for one of the different wisdom dimensions: factual and procedural knowledge; contextualism; value relativism; change of perspective; empathy; relativization of problems and aspirations; self-relativization; self-distance; perception and acceptance of emotions; emotional serenity and humor; long-term perspective, uncertainty tolerance. The introductory statement is "In the following you will find statements which describe how people react to problems and burdens in life. You may agree or disagree or be undecided. Please answer all items". Statements then followed, including the following examples: "It is better to be content with what you have, instead to shed tears about what you do not have" (relativization of problems and aspirations), "I try not to take myself too important" (self-relativization), "What is good or bad depends essentially on the framework conditions" (contextualism), "In my opinion, everyone should be happy in his own way" (value relativism), "Before I respond to a problem, it is important for me to first understand what the problem is" (factual and procedural knowledge), or "I am a person who thinks what happens will happen" (uncertainty tolerance). The task of the participants is to indicate on a six-point Likert scale (1 = do not agree at all to 6 = agree exactly) the extent to which they agree with each of the twelve statements. A global wisdom score can be calculated as an average score across all items. Cronbach's alpha was α = .67 in this present study, signaling that the items are not too narrowly correlated and reflect different contents (i.e. different wisdom capacities).

Presentation of Infection Data: Experimental Manipulation. The experimental manipulation was done by two versions of a figure (Figure 2, 3) which shows the corona infections over a certain time. Data shown in the figure were real life data from the time point of investigation (first half of the year 2021). Participants were instructed to watch the figure and then ad hoc report on a seven-point Likert scale how they globally feel with this. For the experimental group, the curve in the figure was presented with a steep increase due to a stretched y-scale, and then remaining on a seemingly high level. For the control group, the curve was neither stretched nor compressed and thus showed a picture of a continuous development of infections on a similar level.

Figure 2. Graphical data presentation with manipulation in the sense of aggravation: a seemingly high increase of corona infection cases is presented to the experimental group

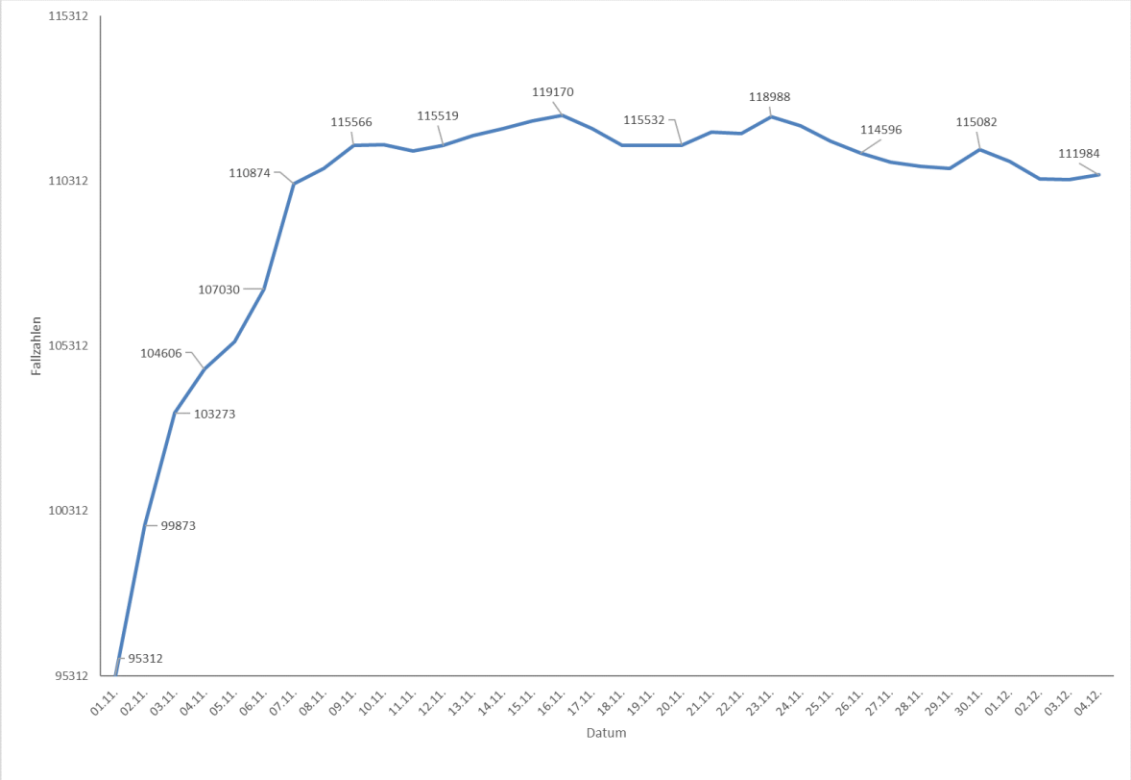
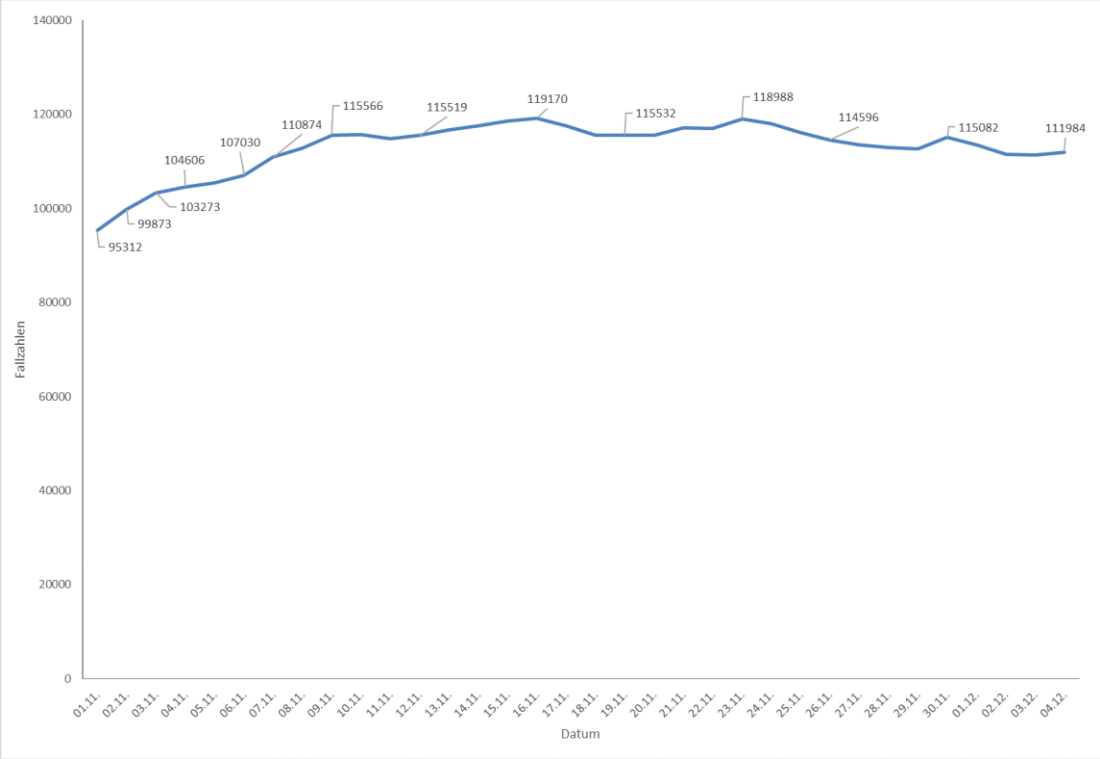


Figure 3. Graphical data presentation without manipulation: a stable course of corona infections with few fluctuations over the time is presented to the control group



Differential Life Burden: DLB Scale. The Differential Life Burden Scale (DLB)[15] measures positive and negative feelings in different life domains. The background is the observation that stress can be both a cause and a consequence of mental health problems, and that emotional stresses in different areas of life differ from one each other. Therefore, they should be considered individually. The scale includes 17 life domains: partnership/marriage, sexuality, children, parents, friends, neighbors/companions, colleagues, work, leisure, health, finances, housing, environment, home, politics, future, and life balance. The DLB is instructed as follows: "Below is a listing of important life domains. Please indicate how you feel when you think of the corresponding life domains. Each item is also completed with the words "When I think of the topic ... my feelings are: very negative (6), negative (5), slightly negative (4), slightly positive (3), positive (2), very positive (1)" The DLB does not provide insights into the actual life circumstances, but rather captures the subjective burden perception in these life domains.[15] The scale has a good internal consistency (Cronbach's alpha α = .74-.77),[15] in this study α = .87 was achieved. The discriminatory power was between r_{it} = .19-.57. Lower item intercorrelations indicate factorial validity. It signals, that different and independent life domains are measured, but there may be a global tendency of rather higher or lower burden perception.

2.3 Participants

293 mostly young people (mean age 26 years), 75% females, participated in the study (Table 1). Almost all were high educated (school leaving certificate with class 12 or 13), and were presently in professional or academic training, 93.9% had already achieved a first degree or finished apprenticeship. The majority had perceived at least one unjust event during the corona pandemic, one third had observed any injustice happening to other persons, and only few (10.2%) did not report any injustice perception during the pandemic months. 3.4% of the here investigated sample had a high embitterment according to the cut-off for clinical relevance.[1] This rate is similar to the rate of 3% found in a large representative survey of all age groups in 2019 (N=2.531)[23] and 2.5% in earlier research,[1] but much lower than the rate of 16% embittered in a population survey of 3.208 persons during the corona pandemic in December 2020.[5]

Baseline embitterment degree was correlated with perceived unjust life events (r=.466, p<.001), i.e. persons who had observed or self-perceived injustices during the pandemic reported higher initial embitterment level. Interestingly, degree of wisdom was independent from the initial embitterment level (r=-.069, p=.236) in the here investigated young persons.

Wisdom was also independent from age in our present sample (r=-.061, p=.296). For comparison: in older samples, there are only low correlations of wisdom and age (r=.15; p=.04, N=202, M=50 years of age)[14].

All characteristics were similarly distributed in control group and experimental group, which signals that randomization was successfully done.

Table 1. Participants´ characteristics. Experimental (presentation of corona increase) and control group (presentation of stable infections) in comparison. Means (standard deviation) or percentages are reported. *N*=293

Characteristics	**Experimental Group presentation of corona infections increase (n=138)**	**Control Group presentation of stable corona infections (n=155)**	**Comparison of Experimental and Control Group**	**All (N=293)**
Age	26.28 (9.35)	25.86 (10.06)	.719	26.06 (9.72)
Females	72.5%	77.4%	.146	75.1%
How do you feel with the facts presented in the figure? very negative =1, very positive = 7	3.12 (1.27) 64.5% slightly to very negative (1-3)	2.97 (1.21) 74.3% slightly to very negative (1-3)	.024 (T-test) .069 (X^2)	69.6%
School degree No leaving certificate 10 classes 12/13 classes	 0.7% 4.3% 94.9%	 0.0% 2.6% 97.4%	.399	 0.3% 3.4% 96.2%
Professional Degree No professional qualification completed Vocational training University diploma Vocational training and university	 41.3% 10.9% 32.6% 15.2%	 50.3% 9.0% 31.6% 9.0%	.273	 46.1% 9.9% 32.1% 11.9%
Unjust events Self-perceived Observed Not affected from any unjust event	 53.6% 38.4% 8.0%	 54.2% 33.5% 12.3%	.407	 53.9% 35.8% 10.2%
General Belief in a Just World (GBJW Pre, rating 1-6)	2.75 (0.83)	2.71 (0.79)	.655	2.73 (0.81)
Wisdom (12-WD Scale Pre, rating 1-6)	4.68 (0.53)	4.69 (0.46)	.868	4.68 (0.50)
Embitterment (PTED scale Pre, rating 0-4) % high embitterment >2.5	1.14 (0.70) 2.9%	1.17 (0.75) 3.9%	.739	1.16 (0.73) 3.4%

3. Results

3.1 Embitterment after neutral or aggravated infection rates reporting

After reading the figure with the infection data, the experimental group who read the aggravated data presentation reported feeling better (M=3.12, Table 1) than the control group (M=2.97).

Embitterment (PTED) changed in the experimental group: participants were less embittered after than before watching the aggravated infection curve (Table 2). In the control group who watched the flat curve (representing the same data), there was hardly difference between pre and post embitterment degree.

3.2 General Belief in a Just World after neutral or aggravated infection rates reporting

General Belief in a Just World (GBJW) decreased in both groups from before to after watching the infection rates (Table 2). Interestingly, the average degree of belief in a just world was only moderate with M=2.73 (SD=0.81) on a scale from 1-6.

Table 2. Development of perception of General Belief in a Just World, and Embitterment, and Differential Life Burden after the manipulation. Analysis of variance with repeated measurement, or T-test. Means (standard deviation) are reported. *N*=293

Embitterment, Belief in a Just World, Life Burdens	**EG CG**	**Pre**	**Post**	**Effect repeated measurement (Pillai´s Trace)**	**Effect repeated measure-ment*group (Pillai´s trace)**
General Belief in a Just World (GBJW)	EG	2.75 (0.83)	2.65 (0.90)	Partial Eta^2.037 *p*<.001	.000 *p*=.780
	CG	2.71 (0.79)	2.62 (0.84)		
Embitterment (PTED)	EG	1.14 (0.70)	1.04 (0.77)	Partial Eta^2.068 *p*<.001	.015 *p*=.034
	CG	1.17 (0.75)	1.13 (0.84)		
Differential Life Burdens (DLB scale, 1=very positive, 6=very negative)	EG		3.30 (0.75)		**T-test** *p*=.833
	CG		3.28 (0.78)		

Note: EG = Experimental group with manipulated presentation of seemingly high increase in infections (n=138). CG = Control group without manipulation: a stable course of corona infections with few fluctuations over the time is presented (n=155).

3.3 Embitterment, wisdom, general belief in a just world and their association with embitterment after watching infection rates

The higher participants agreed to wisdom ideas (12-WD scale) in the beginning, the lower was their embitterment (PTED) and life burden perception (DLB) after watching the infection rates (Table 3).

A high believe in a just world (GBJW) was associated with lower life burden perception after watching the infection rates, but not associated with embitterment after watching the figure.

The experimental manipulation (aggravated versus neutral display of infection rates) only had an impact on embitterment degree after watching the figure, but not on belief in a just world or life burden perception.

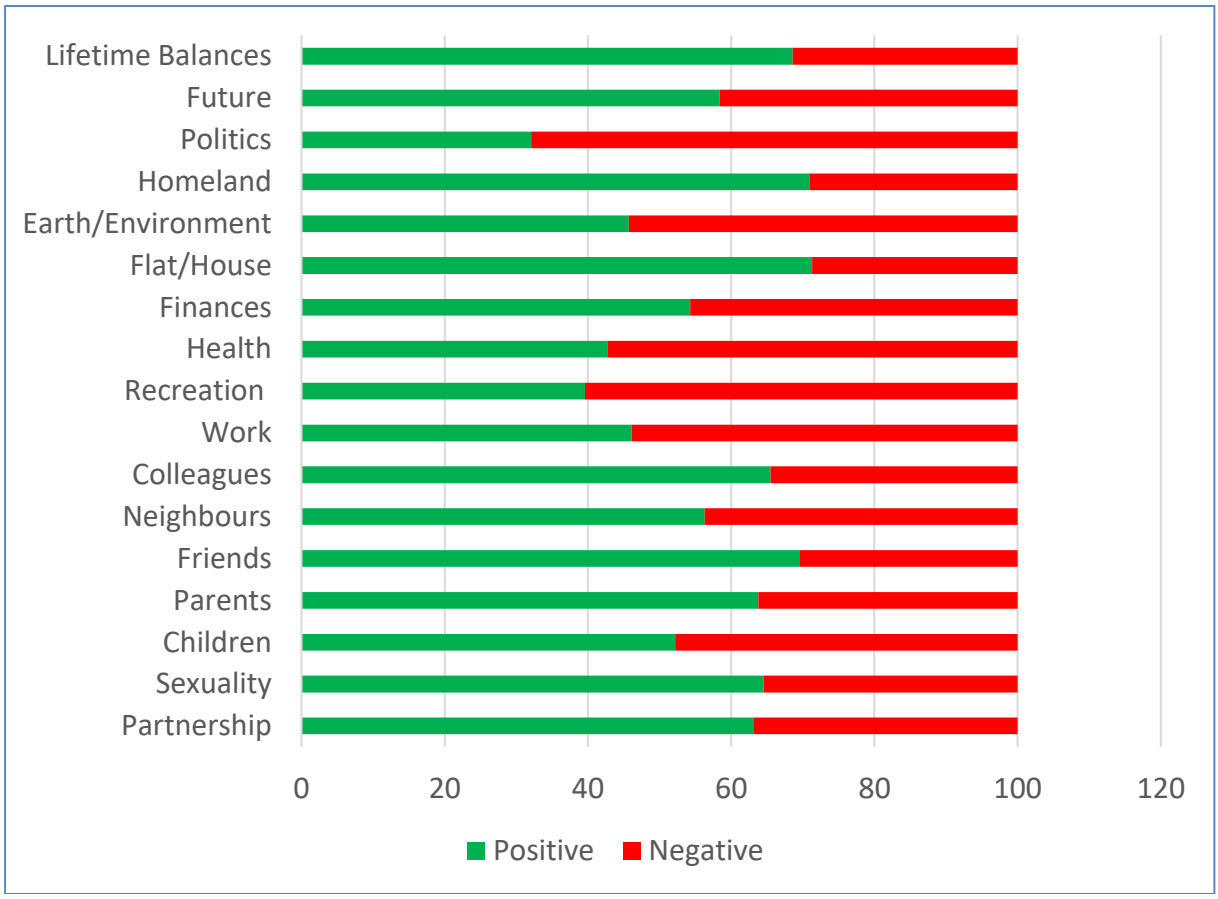
Table 3. Embitterment, Belief in a Just World and Perception of Life Burden after watching a – neutral or aggravated - figure on infection rates. Linear regression analysis. *N*=293

Characteristics	**Embitterment (PTED) Post**		**Belief in a Just World (GBJW) Post**		**Life Burden Perception (DLB) Post**	
	Standardized regression coefficient beta	**Signifi-cance *p***	**Standardized regression coefficient beta**	**Signifi-cance *p***	**Standardized regression coefficient beta**	**Signifi-cance *p***
Age	-.013	.519	-.013	.706	-.066	.247
Professional degree	.011	.591	.055	.101	-.105	.067
Injustice events perceived (1), observed (2), not perceived (3)	-.004	.845	.003	.921	-.003	.959
General Belief in a Just World (GBJW) Pre	.010	.599	.853	<.001	-.151	.004
Embitterment (PTED) Pre	.940	<.001	-.031	.377	.317	<.001
Wisdom (12-WD Scale) Pre	-.044	.020	.047	.126	-.269	<.001
Figure presentation group (0=control group: neutral, 1=experimental group: aggravated infections numbers)	-.041	.030	-.012	.696	.032	.539

3.4 Life Burdens and Life Satisfaction

Both groups reported a similar perception of – only few - life burdens (DLB scale) after watching the infection curves. Participants reported on average rather positive feelings over all different life domains (Figure 4). However, at least one third of the participants reported life domains as more or less burdening. Thereby the own flat (28.7%) and homeland (29.0%) were least often reported as burdening, whereas politics was perceived as burdening by 67.9% of the investigated, and the recreation domain by 60.4%. There were no significant differences in perception of life burdens and satisfaction between experimental and control group.

Figure 4. Life satisfaction or burden reported on the Differential Life Burdens Scale (DLB scale, Linden & Ritter, 2007) by the study participants at the time point of investigation. *N*=293



4 Discussion

The assumption that increased injustices will be experienced during the pandemic was a basis for this study. In the survey, about 90% of the participants reported that they had experienced injustice in the context of the pandemic or had observed it in others. Despite this high rate of injustice perception, the rate of embittered was rather low, similar to population surveys before the pandemic.[1,23] This gave a homogenous basis for a possible increase of embitterment by aggravated data presentation, as was hypothesized in the first experimental research question.

4.1 Embitterment after neutral or aggravated presentation of infection rates

In contrast to experimental hypothesis, embitterment did not increase in any of the two data presentations, but slightly decreased in the version displaying infections in an aggravated manner. The experimental group felt better after reading the aggravated figure than the control group felt after reading the neutral figure.

This might appear contradictory on the first view, as it could have been assumed that aggravated data presentation (EG) would be understood as more negative than a neutral one in which the infection rates optically did not strongly increase. However, there might be a

paradox effect: The figure displaying – more neutrally - a stable high line of infections (CG) may induce the idea "everything is bad, and it continuous to be bad". In contrast, the figure presenting an increase of infection rates (EG) might induce reframing ideas such as "there has been a strong increase in infections, everything is growing bad, so I can be happy not to belong to a risk group, or not to be infected".

The presentation of infections increase in the EG may have emphasized the subsequent stagnation in infection rates and thus implicitly signal some effectiveness of the protection measures. This could then have led to the opposite effect, since it might signal that the measures were not unnecessary, but somehow appropriate. This might have compensated and even reduced injustice perceptions and anger in the EG. In contrast, the neutral figure (CG) presents a picture of stable high infections. This could have the implicit effect to make the restrictions appear hardly effective and therefore annoying or unfair. Accordingly, it can be assumed that the manipulation has succeeded in the opposite direction than initially expected. Certain representations of information may have the potential to change embitterment (state) affect.

In another experiment[8], a pandemic-focused text resulted in more negative emotions. Reading a text can be a stronger priming stimulus than a simple figure with representation of numbers. But, also in our study a "small" manipulation was enough to induce a psychological reaction. These examples show that special care must be taken when presenting pandemic-related information in order not to additionally increase the psychological burden in the population even more. In addition to graphics and text, photos and animated images are also frequently used to convey information. These could also be used in different variations on pandemic-related topics to check for possible effects on psychological reactions. In the context of a bomb attack Holman and colleagues[24] found that particularly bloody images intensified stress and anxiety reactions. This could also be relevant in relation to health crisis, for example when pictures of overcrowded intensive care units or similar are shown.

4.2 General Belief in a Just World after neutral or aggravated presentation of infection rates

GBJW slightly decreased over the course, in both the EG and the CG. As a basic belief, GBJW is a (trait) characteristic and less reactive to external stressors, as compared to (state) affects such as embitterment.

In both groups the figure presenting the infection rates was rated as rather negative. But, it may be that the manipulation did not impact specifically in EG or CG, because a figure is no personally important negative life event with the power to reduce GBJW. In other studies, which found associations between negative life events and reduced GBJW,[25,26] negative life events such as a financial crisis, or the end of a relationship were considered, or situation after an earthquake. It may be possible that strong and directly experienced negative events can lead to a reduction in GBJW rather than information.

Furthermore, even the initial GBJW (pre) was comparatively low in this sample. If the GBJW is rather weak, perception of injustice or being exposed to disliked data presentations is not a contradiction. Thus, no strong effort is necessary for a cognitive integration of injustice perceptions into the own (low) GBJW.[27]

4.3 Embitterment, wisdom, belief in a just world and their association with embitterment after watching infection rates

At baseline, people with higher embitterment reported more injustice events, which is in line with previous research in other samples[28]. But, there was no association found between perceived injustice events and embitterment

after watching the infection data figure. This signals that the here observed change in embitterment affect is associated with the manipulation (infection figure) and thus independent from the before mentioned injustice events.

There were only two aspects which were important for the later embitterment:

Firstly, as already reported, a specific manipulation (the aggravated infection rates figure, EG) itself can lead to change (i.e. decrease) of embitterment level.

Secondly, it can be seen, that wisdom is of importance for the development of embitterment: People with higher wisdom scores had a lower embitterment level after watching the infection data. This fits to clinical observations, and other empirical findings which report that persons with higher wisdom are less affected from embitterment, and which show that the training of wisdom can lead to reduction of embitterment.[11]

Additionally, higher general belief in a just world, lower embitterment, and higher wisdom at baseline were associated with lower life burden perception, which is also in line with findings from other studies on embitterment-accompanying characteristics.[29-31]

4.4 Life Burdens and Life Satisfaction

The young sample investigated here was rather positive about their life domains. However, especially the life domain politics (67.9%), but also environment, work, and recreation were seen negative by at least half of the investigated. The fact that there were no differences between the two groups shows that watching a figure with infection rates does not impact on the perception and satisfaction of one´s own concrete life situation. The average score of 3 of our present sample shows rather good life satisfaction and is similar to DLB scores in a general German population sample from another study (*M*=2.59)[32] before the pandemic. In this earlier study, also politics was rated worse (*M*=4.77), but partnership, family and friends best (M=1.74-1.99), as well as recreation (*M*=1.58). Our present sample however was dissatisfied with their recreation domains. This is explainable due to the pandemic-related acute restrictions (closed shops, sport centers, cinemas and theaters) at the time of investigation. Restrictions in recreational domains directly affect people´s life concretely, whereas politics is a rather abstract issue, which people may perceive as dissatisfactory, may it be in times of pandemic, or other national or worldwide problems.

Compared with other world regions, the global life burden perception in our sample was lower than scores found in South African samples before the pandemic (about *M*=4, tendentially rather low life satisfaction)[33].

5 Limitations

In this study one example has been chosen to test whether and in which aspects presentation of pandemic-related information have the potential to impact on persons affect (here: embitterment) and cognition (here: belief in a just world). There are many other constellations which could be tested with different outcomes, e.g. with varying the presentation format (e.g. videos, photos), and contents (e.g. emotional contents instead of numerical data).

The sample was homogenous in being young and mostly female, with a high education background and in similar professional situation. Thus, although these persons were similarly exposed to the pandemic conditions and restrictions like other people, such characteristics may bring advantages for coping, better mental health, and may come along with a lower embitterment and burden perception. In larger and more heterogenous samples, higher rates of embitterment have been found.[5] In people prone for mental health problems, reactions on such stressor-associated triggers might be different.

As a methodological artefact, regression to mean in repeated measurement may account for a part of embitterment decrease.

6 Conclusion

By means of pandemic-related data presentation, state mood, in the sense of embitterment affect, can be changed. Contradictory to expectation, a figure showing infection rates as increasing lead to reduction of embitterment, whereas after watching a neutral figure with a stable high level of infections embitterment hardly changed embitterment. This example shows that even simple but specific information representations can induce changes in affect, and this functions independently from other relevant characteristics (such as perceived injustice events during pandemic, or general belief in a just world).

There are many ways how inaccurate or manipulated presentation of data can be done without actually falsifying data, for example by truncating, compressing or stretching axes.[34] During large crisis and parallel infodemics,[35] it seems important to keep in mind that the way information and data is presented can influence psychological responses in many different ways, even differently from theoretically expected. Professionals who present event-related data in public should explain them and be aware that information and data presentation may relevantly impact on peoples affects.

Availability of data and material

Data and material are available from the authors upon request.

Conflict of interest

The authors have no conflicts of interest to declare.

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Ethics

A positive ethics vote was granted before the start of the study at the Faculty of Life Sciences, Technische Universität Braunschweig (FV-2020-19).

Contributions of the authors

B.M. provided the research question and the design and supervised the research project. E.M. conducted the data collection, literature review, and preliminary data analyses. B.M. analyzed the data, wrote the final manuscript and made revisions.

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