Factors affecting “expectations of the unexpected”: The impact of controllability & valence on unexpected outcomes

Molly S. Quinn a, *, Mark T. Keane a, b

a School of Computer Science, University College Dublin, Ireland
b Insight Centre for Data Analytics, University College Dublin, Ireland

A R T I C L E   I N F O

Keywords:
Negativity bias
Control
Unexpectedness
Explanation

A B S T R A C T

Do people have specific “expectations about the unexpected” when they think about the future? Recent work supports a “negativity bias”, that people expect future events to be disrupted by unexpected negative outcomes. However, when the current situation is negative, they report more positive unexpected outcomes (e.g., negative experiences lead many to imagine a future of unexpected positive outcomes). The present study (N = 219 Prolific.co participants; with a pre-test of N = 64) explored whether people also show an “uncontrollability bias”;

best-laid plans are often disrupted by uncontrollable events. People thought of unexpected outcomes for 8 everyday scenarios, matched on valence and controllability, generating a total of 1752 distinct responses. Participants mainly report negative-uncontrollable unexpected events (34%). However, in contrast to prior work (i) negatively-valenced scenarios elicit more controllable unexpected outcomes, and (ii) uncontrollable scenarios elicit more positive unexpected outcomes. The implications of these results for everyday cognition and decision making are discussed.

Our “expectations about the unexpected” must influence how we respond to the world, especially if that world is unpredictable and threatening. If I expect my future to involve unexpected, negative events that are outside of my control, then I may well be cautious. In contrast, if I think my future involves unexpected, positive events within my control, then I may take risks. For instance, in the current pandemic, even after vaccination, many people hesitate to exit lockdowns, thinking they might “unexpectedly” contract COVID-19. Even though expectations about the unexpected clearly play a critical role in everyday cognition, surprisingly few studies have directly analysed how their reports of the unexpected. So, we do not know much about (i) how people conceive of the unexpected, (ii) what factors influence their expectations of the unexpected, and (iii) whether they are biased towards thinking of particular outcomes. Here, we asked people to “think of the unexpected” for everyday scenarios and analysed how their reports of the unexpected are affected by the valence (positive or negative) and controllability (controllable or uncontrollable) of these scenarios.

Consider some possible “expectations of the unexpected” for a simple everyday scenario. Given a story about Lucy who wants to buy a new car but is financially challenged, one is asked to imagine what could unexpectedly happen. One might imagine positive outcomes in which “Lucy wins the lottery” or “sells her classic vinyl-record collection” to finance the purchase; these positive outcomes differ in that the former happens by chance (uncontrolled) whereas the latter arises from an intentional act (controlled). However, one could also imagine other unexpected possibilities involving negative outcomes; that “Lucy is repeatedly refused a bank loan” (uncontrolled) or that “Lucy crashes her car to claim the insurance on it” (controlled). In theory, all these unexpected outcomes are equally plausible (or implausible). Yet, as we shall see, people show distinct tendencies to mention certain types of outcomes, appearing to have definite “expectations” about the unexpected events they envision.

What determines people’s conception of the unexpected? One account argues that, in everyday life, people track and store disruptions to plans as schematic structures in memory (Leake, 1992, 1993; Schank, 1986; Schank & Kass, 1990; Schank, Kass, & Riesbeck, 1994). We use these – so-called explanation patterns – to explain unexpected events that arise. Therefore, when people are asked about the unexpected, they essentially report instantiations of these schemas. For Lucy’s story, common unexpected impacts on an actor’s purchasing plans involve “not having enough money” or “having a cash windfall”, and these are what people report (Quinn, Campbell, & Keane, 2021). This theory...
makes two key predictions. First, that the “unexpected” is relatively mundane and somewhat unsurprising (see Foster and Keane, 2015, evidence from surprise studies). Second, it predicts that the unexpected is more likely to be negative and uncontrollable. Most human action is goal-driven and designed to benefit the instigating actor. So, the “expected” tends to be what we intend, control and wish for (i.e., positive and controllable). A priori, explanation patterns in memory will tend to record disruptive events that are negative and uncontrollable. However, this may not be the only factor determining people’s conception of the unexpected.

Expectations of the unexpected should also be influenced by the actors’ current circumstances. Recently, Quinn et al. (2021) found that a dominant negativity bias for unexpected outcomes could be suppressed by the valence of the current scenario. Quinn et al. (2021) found a strong negativity bias in people’s reports of unexpected outcomes to everyday scenarios (e.g., going shopping, gardening), presumably because everyday expectations are typically positive (Baumeister, 2020; Bohner, Bless, Schwarz, & Strack, 1988; Unkelbach, Alves, & Koch, 2020). However, they also found that significantly more positive unexpected events were reported for negative scenarios (from 24% for positive scenarios to 40% for negative scenarios). To explain this effect, they proposed a valence-countering hypothesis, that people were anchored by the valence of the current scenario and countered this valence when thinking of the unexpected. When the current situation was negative (“Mary gets a pay cut at work”) then the unexpected outcome was countered to be positive (“Mary’s co-workers throw her a surprise party”). However, this countering occurs against the backdrop of a dominant negativity bias; the unexpected is more likely to be negative, but this negativity can be somewhat suppressed by the current circumstances. Similar effects have been reported in people’s attribution expectations; when given valenced information about someone, an opposite-valenced target statement - whether positive or negative elicits the same surprise (i.e., negativity bias is not found; Brannon & Gawronksi, 2018; Brannon, Sacchi, & Gawronski, 2017).

In this paper, we consider the influence of controllability as well as valence, as control is also important in people’s appraisal of everyday events (Bandura, 1978, 2012; Frazier & Caston, 2015); indeed, controllability is often jointly manipulated with valence (Baumeister, Bratslavsky, Finkenaier, & Vohs, 2001) and sometimes confounded with it (Gold & Martyn, 2003). We predict an uncontrollability bias, analogous to the negativity bias, in which the unexpected is assumed to involve uncontrollable events (e.g., Lucy wins the lottery or is refused a loan). The unexpected is typically unplanned and outside of one’s control (e.g., surprising gains or bad accidents). However, as with valence, this bias may be influenced by current circumstances; that is, even though the prior the unexpected is typically uncontrollable, this uncontrollability may be suppressed when the initial circumstances are uncontrollable. Unfortunately, prior work does not tell us whether such effects are likely to occur.

In counterfactual reasoning, people are more likely to change controllable factors preceding negative outcomes (Girotto, Legrenzi, & Rizzo, 1991; Maloney & Egan, 2017; McCloy & Byrne, 2000; Roese, Smallman, & Epstude, 2017). Upward counterfactuals, focusing on better alternative events, are more common in response to controllable outcomes, whereas downward counterfactuals are found for uncontrollable outcomes (Roese & Olson, 1995). However, these findings address imagined alternatives for past events, not future outcomes. In hindsight bias, negative events elicit less bias overall, while controllable outcomes elicit more bias when measured by foreseeability, but less bias when measured by inevitability (Blank & Peters, 2010; Pezzo & Beckstead, 2008; Roese & Vohs, 2012). Although these findings support the idea that negative outcomes are more unexpected, and controllable outcomes more expected, hindsight bias is by definition an after-the-fact bias, not an account of prospective thinking. Unrealistic optimism is seen to a greater degree for both negative and controllable events (Weinstein, Harris, & Hahn, 1980). However, when controllability is carefully separated from valence, only valence predicts unrealistic optimism (Gold & de Sousa, 2012; Gold & Martyn, 2003). Although this literature provides a motivational explanation for the suppression of the negativity bias in response to negative materials, it tells us little about the expected controllability of the outcome in response to the controllability of the current scenario. In research on surprise, unexpected and uncontrollable successes have been shown to be more surprising than analogous failures, and unexpected but controlled failures are more surprising than successes (Teigen & Keren, 2002). However, none of this work gives us strong indications as to what will happen in the current task; at best, they suggest that people’s reports of the unexpected will involve both positive, uncontrollable events as well as negative, uncontrollable events, with few indications as to which may dominate.

Our working hypotheses are that (i) overall, people will manifest an “uncontrollability bias”, reporting more uncontrollable than controllable unexpected outcomes, as the unexpected tends to involve unplanned events, (ii) controllability-countering will occur, such that, when the current scenario is within an actor’s control, the unexpected will be countered to be uncontrollable, and vice versa. In the present experiment, controllability is manipulated in everyday scenarios by stating that the means for the main goals of the actors are present (e.g., Lucy learns her trade-in car is a classic and worth thousands) or absent (e.g., Lucy learns her trade-in car is a wreck and worth nothing). The present experiment also manipulates valence as it tends to be related to controllability. However, we do not make any predictions about interactions between valence and controllability. The experiment has a 2 × 2 between-participants design examining the variables of controllability (controllable v uncontrollable) and valence (positive v negative). Before the experiment, we conducted pre-tests to validate the matched material conditions.

1. Methods

1.1. Design & participants

The study used a between-subjects design for the two binary categorical independent variables, Valence (negative or positive) and Controllability (uncontrollable or controllable). So, participants were assigned to one of the four groups: Negative-Uncontrollable, Positive-Uncontrollable, Negative-Controllable, Positive-Controllable receiving matched variants of the materials. An a priori power analysis was conducted to determine the necessary sample size for a binomial logistic regression with two dichotomous predictor variables. Previous research has reported a small effect size of OR = 2.04 for the valence predictor (Chen, Cohen, & Chen, 2010; Quinn et al., 2021), and a very small effect size (OR = 1.17) was found for the interaction effect in the pilot test of this study; as such, we estimated a small effect size (OR = 2.04) to maximise the likelihood of correctly rejecting the null hypothesis for the main effects. Following accepted guidelines (Verma & Verma, 2020), G*Power determined that a sample size of N = 218 would be sufficient to observe an effect of this size at an alpha of 0.05 and power of 0.80 for a one-tailed test with a binomial distribution in which the probability of a negative outcome is 0.56 when the predictor variable of valence is negative (based on prior work; Quinn et al., 2021), and when the predictor variables of valence and controllability are not correlated.

Two-hundred and twenty participants were recruited on the Prolific crowdsourcing platform. One participant failed to complete the study, leaving 219 participants in total. The mean age of participants was 34.75 years (SD = 12.56). Participants were 63.76% female and 36.24% male and all were native English speakers from the UK (89.04%), US (5.48%), or Ireland (5.48%). The study was preregistered on the Open Science Framework (osf.io/u7hkn).1

1 Data and analysis code are available at https://github.com/MollySQuinn/Controllability_and_Valence_in_Unexpected_Events.
1.2. Materials & procedure

The materials consisted of simple scenarios describing common everyday scenarios (e.g., going shopping, gardening; based on materials proposed by Foster and Keane (2015) and Quinn et al. (2021)). Four variants of each scenario were created to change its valence (by modifying a key sentence to be positive or negative) and controllability (modifying the stated means for the main goal to be present or absent): the four versions being uncontrollable-negative, uncontrollable-positive, controllable-negative, and controllable-positive scenarios. A pre-test validated the materials, in which participants (N = 64) rated the valence and controllability of each scenario on a 7-point Likert-type scale. Eight materials out of an original set of 20 met the criteria for the main experiment. Valenced versions of these eight materials were categorised as positive (M = 5.60) or negative (M = 3.08) based on having significantly different mean valence ratings (both ps < 0.001 using t-tests) in the required direction within their respective controllability conditions. Controllable versions of these eight materials were categorised as controllable (M = 4.99, of a possible 1–7 on the Likert scale) or uncontrollable (M = 3.75, of a possible 1–7 on the Likert scale) based on having significantly different mean controllability ratings (both ps = 0.01 using t-tests) in the required direction within their respective valence conditions.

Each participant initially completed a consent form and explicitly agreed to participate in the study. Instructions on the task were given and two practice materials were presented. Each of the four groups then was presented with the eight scenarios one after the other on separate pages reflecting the variables being tested (randomly re-ordered for each participant). After reading each scenario, they were asked the non-valenced question, “Then, something unexpected happened. What do you think happened?” They then wrote their response in a free-text box. Data collection from human subjects for all experiments listed was conducted with the approval of University College Dublin’s ethics review board [LS-E-18-115-Keane-Exemption].

1.3. Measures

In all, the study generated 1752 responses (219 participants by 8 materials) reflecting the unexpected outcomes reported for the presented scenarios. Two raters independently labelled these responses on three criteria: they judged (i) the valence of described outcome (positive, negative or neither), (ii) the controllability of the outcome (uncontrollable, controllable or neither), and (iii) the answer category of the outcome. For the valence judgement, raters were instructed to consider the overall positivity/negativity of the events described. For the controllability judgement, raters were asked to determine whether or not the event could be considered to be controllable by the main actor in the scenario. The latter was defined as an event that is largely, if not fully, in the control of the actor or if they are making a decision, taking an action, and if no decision or action is given, or if the events described could be caused or prevented by intervention of the actor in the scenario; preventable accidents (e.g., accidently knocking over the tea pot) were also included in this definition of controllable events. For the answer-category judgement, raters were provided with a list of specific outcome-categories for each scenario (established in earlier studies; Quinn, Campbell, & Keane, 2019; Quinn et al., 2021) and had to classify the stated outcomes as one of these or as “other”; in general, each scenario has between x and y distinct answer-categories on which people tend to agree (e.g., for the Lucy car-buying scenario typical answer categories are “being refused a loan”, “car worth more than expected”, “decides to keep old car” and “gets money from old car or its parts”). Responses on which the raters disagreed were resolved by consensus; across all materials, disagreements occurred in 14% of the answer categories, 13% of controllability categories, 5% of valence categories. The three sets of judgements showed high inter-rater agreement given by Cohen’s Kappa on answers K = 0.83, valence K = 0.87, and good inter-rater agreement for controllability K = 0.66.

1.4. Statistical analysis

The pre-registration of this study cast it as a binomial logistic regression for the independent variables of Valence and Controllability. These choices were reasonable given that previous work found that the “neither” category was seldom used for the Valence variable (typically, ≤ 7.4% of the time) (Quinn et al., 2021). However, the Controllability variable gave rise to higher levels of “neither” responses (about 20%), so it was decided to include this category in initial analyses using the Chi-square statistic. These Chi-square tests assessed the differences in a reported-outcome’s Valence (negative, positive, neither) and Controllability (uncontrollable, controllable, neither) by condition. A post-hoc power analysis showed that for a Chi-square test with 6 degrees of freedom, 219 participants, α = 0.05, and a small effect size w = 0.10, we achieve a power of 0.15 and that for the same design with a medium effect size w = 0.30, we achieve a power of 0.94. Hence, the power for identifying a small-effect size with this analysis is more limited than originally planned.

2. Results

Overall, the frequencies of reported unexpected outcomes (N = 1752 responses) reflect a negativity bias (57% were negative outcomes) and an uncontrollability bias (55% were uncontrollable outcomes). Indeed, these two biases appear to combine to make negative-uncontrollable outcomes the majority response across the four conditions (at 34%), though some conditions contribute more than others to this overall figure. However, these results mask dependencies between the two variables, in which (i) the valence of the scenario is found to affect outcome controllability and (ii) the controllability of the scenario is found to affect valence of outcomes. A by-material analysis using (i) a negativity index (based on log odds) shows that the controllability of the scenario suppresses the negativity bias, and (ii) a controllability index (again based on log odds) shows that the valence of the scenario suppresses the uncontrollability bias. The following subsections describe the results for (i) the valence frequencies of the unexpected outcomes reported, (ii) the controllability frequencies of the unexpected outcomes reported, (iii) the log odds for negative outcomes by material for the controllability conditions, (iv) the log odds for uncontrollable outcomes by material for the valence conditions, and (v) an analysis of frequencies of outcomes for valence and controllability combined.

2.1. Frequency of unexpected outcomes: Valence

Fig. 1 shows the proportion of reported outcomes that were negative or positive in the four conditions of the study (the Negative-Uncontrollable, Positive-Uncontrollable, Negative-Controllable, Positive-Controllable conditions). Overall, collapsing across these four conditions, people show a marked negativity bias generating more negative unexpected-outcomes (57%) than positive unexpected-outcomes (35%; 8% of responses were “neither”). There was an overall significant difference between the frequencies of positive and negative outcomes between the groups, χ²(6, N = 1752) = 133.70, p < .001, ν = 0.195. As these frequencies are not strictly independent, chi-square tests were also run on each individual material (see Supplementary Material); these analyses showed that seven material-scenarios confirm this pattern of effects (all ps < 0.05) with one material failing to be significantly different (the John-Party Scenario, χ²(3, N = 201.0) = 6.47, p = .091, ν = 0.179).²

² All chi-square test statistics and p values in this paper are calculated using William’s correction for multiple comparisons and were based on frequencies of responses in the negative, positive, and neither categories.
When valence and controllability are explicitly manipulated, valence-countering occurs more frequently when the scenarios are controllable as opposed to uncontrollable. Chi-squared analyses for pairwise comparisons between conditions show that frequencies of negative outcomes are no different between the Negative-Uncontrollable (42.73%) and Positive-Uncontrollable (46.23%) conditions ($\chi^2(2, N = 880) = 2.88$, $p = .237$, $\nu = 0.057$; see Fig. 1). However, frequencies of negative outcomes do differ significantly between the Negative-Controllable (63.66%) and Positive-Controllable (74.32%) conditions ($\chi^2(2, N = 872) = 15.45$, $p < .001$, $\nu = 0.133$; see Fig. 1)$^2$. Furthermore, all the Uncontrollable conditions produce reliably fewer negative outcomes than the Controllable conditions (see Fig. 1); Negative-Uncontrollable (42.73%) is reliably different from Negative-Controllable (63.66%; $\chi^2(2, N = 872) = 52.66$, $p < .001$, $\nu = 0.246$) and Positive-Uncontrollable (46.36%) is reliably different from the Positive-Controllable (72.32%; $\chi^2(2, N = 880) = 71.51$, $p < .001$, $\nu = 0.285$) conditions. As we shall see, these patterns are confirmed in by-materials analyses using a “negativity index” (measured using log odds).

2.2. Frequency of unexpected outcomes: Controllability

Fig. 2 shows the proportion of reported outcomes that were uncontrollable or controllable in the four conditions of the study (the Negative-Uncontrollable, Positive-Uncontrollable, Negative-Controllable, Positive-Controllable conditions). Overall, collapsing across these four conditions, people show a marked uncontrollability bias reporting more uncontrollable unexpected-outcomes (55.02%) than controllable ones (25.46%; 19.52% of responses were “neither”). There was an overall significant difference between the frequencies of uncontrollable and controllable outcomes between the groups, $\chi^2(6, N = 1752) = 19.49$, $p = .003$, $\nu = 0.075$. As these frequencies are not strictly independent, chi-square tests were also run on each individual material; these analyses showed that three scenarios confirm this pattern of effects ($ps < 0.05$) with, two others approaching significance - the John-Party-Scenario $\chi^2(6, N = 219) = 11.99$, $p = .062$, $\nu = 0.165$) and Lucy-Loan-Scenario $\chi^2(6, N = 219) = 11.10$, $p = .085$, $\nu = 0.159$ - and three materials failing to be significantly different (see Appendix B).

However, though this uncontrollability bias is found within all four groups, the extent of the bias differs between groups. In all four groups, people are much more likely to report uncontrollable unexpected outcomes: Negative-Uncontrollable (49.55%), Positive-Uncontrollable (60.23%), Negative-Controllable (50.69%), and Positive-Controllable (59.55%). However, in pairwise comparisons between conditions the uncontrollability bias is only reliably different between the (i) Negative-Uncontrollable (49.55%) and Positive-Uncontrollable (60.23%); $\chi^2(2, N = 880) = 11.79$, $p = .003$, $\nu = 0.116$) conditions, and (ii) Negative-Controllable (50.69%) and the Positive-Controllable (59.55%); $\chi^2(2, N = 872) = 6.96$, $p = .031$, $\nu = 0.089$) conditions (see Fig. 2). Pairwise comparisons between controllable and uncontrollable within their respective valence categories were not reliably different (all $p > .05$).

Concretely, these results show that the valence of the scenario (positive or negative) is the main determinant of the uncontrollability bias. As a corollary, this finding also means that the proposed countering hypothesis for controllability – that people flip the scenario from uncontrollable-to-uncontrollable or uncontrollable-to-controllable – is not supported by the evidence.

2.3. Log odds of negative outcomes: By-material analysis using a negativity index

In assessing the strength of a bias under different conditions it is useful to have a single number to quantify it, a negativity index. At the level of individual materials, the log odds of a negative outcome being reported is a useful index (i.e., $\log(p/(1-p))$ where $p$ is the probability of a negative outcome). When the log odds score is a positive number it means that negative outcomes are more likely to be reported, and higher log odds scores reflect higher proportions of negative outcomes, overall. When the log odds score is a negative number it means that positive outcomes dominate. Accordingly, this negativity index can reveal the suppression of the negativity bias when the scores of uncontrollable variants of a material shift lower relative to those of controllable variants. Fig. 3 shows this measure for controllable and uncontrollable variants in each of the 8 materials, for purposes of comparison. In this by-materials analysis, four main results emerge: (i) all 8 materials show a suppression of the negativity bias, with lower scores in uncontrollable versions of a material compared to controllable versions, (ii) 3 materials (michael-breakfast, bill-holiday, and sally-wine) shift from a minus score to a minus score, indicating that the suppression shifts responding from being predominantly negative to predominantly positive in the uncontrollable version of the material, (iii) for 4 materials (belinda-meeting, rebecca-swimming, john-party and sean-call) both variants are dominated by negative outcomes, but nevertheless, the scores shift lower in

Note: that this result confirms a small effect of valence-countering but one that occurs within an overall effect dominated by controllability.
the uncontrollable variants, and (iv) 1 material (lucy-loan) has predominantly positive outcomes for both variants, but still shifts to be even more positive in the uncontrollable variants. As such, Fig. 3 visualises the suppression of the negativity bias as a function of the controllability variable in the study.

2.4. Log odds of uncontrollable outcomes: By-materials analysis using an uncontrollability index

An uncontrollability index, analogous to the negativity index, can also be computed for the uncontrollability bias, for each material, to show how it is suppressed by the valence variable. This index is computed using the log odds of an uncontrollable outcome being reported (i.e., log (p/(1-p)) where p is the probability of an uncontrollable outcome). Here, when the log odds score is a positive number it means that uncontrollable outcomes are more likely to be produced, and a higher log odds score reflects higher proportions of uncontrollable outcomes, overall. Accordingly, this uncontrollability index can reveal the suppression of the uncontrollability bias when the scores of negative variants of a material shift lower relative to those of positive variants. Fig. 4 shows this measure for positive and negative variants in each of the 8 materials, for purposes of comparison. In this by-materials analysis, two main findings occur: (i) 5 out of 8 materials show a suppression of the uncontrollability bias, with the negative variants scoring lower than positive variants, (ii) 3 materials (michael-breakfast, bill-holiday, belinda-meeting) show essentially no change in the score indicating no suppression effect. Fig. 3 visualises the suppression of the uncontrollability bias as a function of the valence variable in the study, for the majority of materials (though the suppression is less pronounced than that found for the negativity bias).

2.5. Frequency of unexpected outcomes: A negative-uncontrollability bias

Finally, there is evidence of a combined “negative-uncontrollability bias”. Overall, the majority of unexpected outcomes reported are both negative and uncontrollable (34.30%; when the neither-categories are excluded this rises to 47%). The next highest unexpected outcome reported was positive and uncontrollable (17.69%; or 24% when the neither-categories are excluded) showing the dominance of the controllability variable described above. The expression of this

Fig. 2. Controllability of unexpected events, reported as uncontrollable and controllable outcomes, in the four conditions of the study. * p < .05, ** p < .005.

Fig. 3. Log odds of reporting a negative outcome (i.e., the negativity index) for the uncontrollable and controllable versions of each material-scenario in the study.
combined bias is quite consistent in each of the study’s four conditions, it being reflected in significantly different distributions of reported outcomes. Three-by-three Chi-square tests, based on classifying outcomes reported by Valence (negative, positive, neither-valence) and Controllability (uncontrollable, controllable, neither-controllable), reveal significantly different distributions for the four conditions: Uncontrollable-Negative ($\chi^2(4, N = 440) = 27.11, p < .001, \nu = 0.176$), Uncontrollable-Positive ($\chi^2(4, N = 440) = 29.57, p < .001, \nu = 0.183$), Controllable-Negative ($\chi^2(4, N = 432) = 29.23, p < .001, \nu = 0.184$), and Controllable-Negative ($\chi^2(4, N = 440) = 11.52, p = .021, \nu = 0.114$) conditions. The only condition in which the dominance of this negative-uncontrollability bias is mitigated is in the Negative-Uncontrollable condition, reflecting the effects negative-uncontrollable scenarios on each of the individual outcome-measures (see Fig. 5). Hence, the individual action of each of the manipulated scenario variables – Valence and Controllability – seems to account for the pattern of results found in the outcome measures.

3. Discussion

The present study’s main finding is that people manifest a negativity and an uncontrollability bias and that these biases are both influenced, respectively, by the controllability and valence of current circumstances. These results have implications for any situation in which people are assessing the future (e.g. decision making, future thinking).

Negativity bias is reflected in people’s tendency to report the unexpected as being predominantly negative. Quinn et al. (2021) found that when circumstances were negative, this negativity was suppressed (resulting in more positive outcomes being reported). However, their material-scenarios were not assessed for controllability. This valence-countering effect was replicated here, but only when the initial scenario was controllable; more negative outcomes are reported for positive-controllable (74.32%) than for the negative-controllable scenarios (63.66%; see Fig. 1). The generation of negative unexpected outcomes is mainly influenced by Controllability; significantly more negative
outcomes are reported when initial scenarios are controllable (69.04% overall) rather than uncontrollable (44.55% overall), irrespective those scenarios being negative/positive (see Fig. 1). If I am buying a car and have the requisite means, then I expect the unexpected outcome to be something bad blocking my goal. However, if I am buying the car and do not have the requisite means, then the unexpected will be something good enabling goal-achievement. Valence countering occurs in the controllable conditions. When the current circumstances are controllable and positive (e.g., ‘I’m happy to sell my old car for a large sum’), then the unexpected outcomes are overwhelmingly negative (e.g., I crash the new car). However, when circumstances are controllable and negative (e.g., ‘I crashed my old car’), then unexpected outcomes tend to be predominantly positive (e.g., ‘I get a good deal on the new car’). These controllability effects on the valence of outcomes prompt a reassessment of previous negativity bias results.

Uncontrollability bias is reflected in people’s tendency to report the unexpected as being predominantly uncontrollable. This is a novel finding from the current study. Furthermore, if the current circumstances are negative then this uncontrollability is suppressed (i.e., more controllable outcomes were reported). So, the predicted controllability-countering effect is not confirmed by these results; rather, the expression of uncontrollable outcomes is heightened by the positivity of the initial scenario. Overall, the generation of uncontrollable unexpected outcomes is mainly influenced by the valence variable; significantly more uncontrollable outcomes are reported for positive scenarios (59.89% overall) over negative ones (50.11% overall), irrespective of whether these outcomes are uncontrollable/controllable (see Fig. 2).

The flip side of this effect is that reporting of controllable outcomes is raised by negative initial circumstances (see Fig. 2). When the current scenario is negative, people imagine actors unexpectedly taking control of circumstances to achieve goals. For instance, when Lucy is sad to sell her car, people tend towards saying she unexpectedly ‘decides to keep her old car’. This finding echoes the counterfactual literature; namely, that people mutable countable events tend to undo or minimise a negative event (Girotto et al., 1991; Maloney & Egan, 2017; McCloy & Byrne, 2000; Roese et al., 2017). Negative events tend to elicit more causal reasoning, facilitate understanding and aid avoiding similar negative events in the future (Baumeister et al., 2001; Bohnet et al., 1988; Rozin & Royzman, 2001; Taylor, 1991). Taylor’s (1991) theory of ‘mobilisation and minimisation’ suggests that people counteract the impact of negative information to repair mood, engender more perceived control and a positive sense of self, as well as optimism about the future. Following this theory, when negative events are already occurring, people are more willing and likely to ‘mobilise’ to change the situation. When asked for unexpected events, people are likely to want to undo the negative situation, and this leads to a search for controllable events which are also unexpected.

From a data-analysis perspective, the current study treats the input variables and output measures categorically in terms of the key variables of controllability and valence. For example, people’s ratings are categorised as a positive or negative valence rather than being treated as a continuous variable from a Likert scale. Arguably, this could be viewed as a limitation of the current study, and it could be better to analyse the results using regression over these pseudo-continuous measures. We have found that such an analysis of the re-coded data (i.e., using the mean rating of valence and controllability from Likert scales used in the pre-test) generates the same overall conclusions as those reported above. However, we believe the categorical approach adopted presents a clearer picture of the – often complex – patterns of results and interactions between these variables. Likewise, we had low power to find small effects given our sample size and analysis set-up, which could be another analytical limitation. There may be further small effects we were unable to assess in the present study.

In a wider context, these findings have implications for situations in which negative unexpected information must be processed. In general, a sense of control over unexpected life events is correlated with better resilience (Turner, Goodin, & Lokey, 2012). In therapy, and research on perceived control and a sense of agency, people are encouraged to have correct beliefs about their level of control over an event (controllable or uncontrollable) in order to recover their well-being when adjusting to a stressful or traumatic event (Frazier & Caston, 2015). In this work, as well, most of the unexpected events generated were uncontrollable. In the face of the unexpected, this may mean recognising that we will not have control over future events, and need to prepare for possible alternatives. This work shows that people mainly predict the unexpected to be negative and uncontrollable; however, when events are already negative and/or uncontrollable, these biases are somewhat lessened.

Finally, from a more theoretical perspective, this work supports Leake’s theory that people store standard disruptions to or failures occurring in everyday events and that they use these stored disruptions when they are asked to imagine the unexpected. This means that people’s conception of the unexpected is not really that “unexpected”; it is the “familiar unexpected” rather than the “truly unexpected”. For example, when asked to consider unexpected events in a shopping-scenario people report mundane, “familiar” disruptions such as “losing one’s money”, “being mugged” or “the shop being closed for the day”. They rarely report unusual, bizarre or surprising events such as “being unwittingly co-opted into a flash mob that is robbing the store”. Quinn et al. (2019) found that when people were instructed to report the “bizarre and unexpected” they still persisted in mainly mentioning these same mundane disruptions. Adaptively, it probably makes sense to be conservative in one’s imaginings of the unexpected, truly unexpected events rarely happen and planning for such events may not be very pragmatic. However, it does mean that people can be significantly blindsided by truly unexpected events; for instance, in the current COVID-19 pandemic, part of the anxiety and disbelief experienced by people arises from the sheer unexpectedness of what has happened and their failure to know what to do when faced with such unforeseen circumstances.

Author contributions

Both authors contributed to the study concept and design. MQ performed data collection and analysis. Both authors contributed to writing the manuscript.

Funding

This work was supported by funding from the (i) School of Computer Science, University College Dublin, and (ii) Science Foundation Ireland (SFI) to the Insight Centre for Data Analytics [12/RC/2289-P2].

Open practices statement

This work was formally preregistered at https://osf.io/u7hnk/. All data and analysis code used in the making of this paper are available at https://github.com/MollySQuinn/Control_and_Valence_inUnexpected_Events.

Acknowledgments

The authors would like to thank Courtney Ford for her work in labelling the data for the main experiment.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.cognition.2022.105142.
References

Bandura, A. (1978). Self-efficacy: Toward a unifying theory of behavioral change. Advances in Behaviour Research and Therapy, 1, 139–161.

Bandura, A. (2012). On the functional properties of perceived self-efficacy revisited. Journal of Management, 38(1), 9–44.

Baumeister, R. F. (2020). Personal communication.

Baumeister, R. F., Bratslavsky, E., Finkenauer, C., & Vohs, K. D. (2001). Bad is stronger than good. Review of General Psychology, 5, 323–370.

Blank, H., & Peters, J. H. (2010). Controllability and hindsight components: Understanding opposite hindsight biases for self-relevant negative event outcomes. Memory and Cognition, 38, 356–365.

Bohner, G., Bless, H., Schwarz, N., & Strack, F. (1988). What triggers causal attributions? The impact of valence and subjective probability. European Journal of Social Psychology, 18, 335–345.

Brannon, S. M., & Gawronski, B. (2018). In search of a negativity bias in expectancy violation. Social Cognition, 36, 199–220.

Brannon, S. M., Sacchi, D. L., & Gawronski, B. (2017). (in)consistency in the eye of the beholder: The roles of warmth, competence, and valence in lay perceptions of inconsistency. Journal of Experimental Social Psychology, 70, 80–94.

Chen, H., Cohen, P., & Chen, S. (2010). How big is a big odds ratio? Interpreting the magnitudes of odds ratios in epidemiological studies. Communications in Statistics: Simulation and Computation, 39, 860–864.

Foster, M. L., & Keane, M. T. (2015). Why some surprises are more surprising than others: Surprise as a metacognitive sense of explanatory difficulty. Cognitive Psychology, 81, 74–116.

Frazer, P., & Caston, J. (2015). Event controllability moderates the relation between perceived control and adjustment to stressors. Journal of Loss and Trauma, 20, 526–540.

Girotto, V., Legrenzi, P., & Rizzo, A. (1991). Event controllability in counterfactual thinking. Acta Psychologica, 78, 111–133.

Gold, R. S., & de Sousa, P. N. (2012). When does event valence affect unrealistic optimism? [PMID: 21745029]. Psychology, Health & Medicine, 17(1), 105–115.

Gold, R. S., & Martyn, K. (2003). Event valence and unrealistic optimism. Psychological Reports, 92(3, suppl), 1105–1109.

Leake, D. B. (1992). Evaluating explanations. Psychology Press.

Leake, D. B. (1993). Focusing construction and selection of abductive hypotheses. In Ljajic ’93 (pp. 24–29).

Maloney, D. M., & Egan, S. M. (2017). The effect of autonomy on counterfactual thinking about controllable events. Journal of Cognitive Psychology, 29, 337–351.

McCloy, R., & Byrne, R. M. (2000). Counterfactual thinking about controllable events. Memory and Cognition, 28, 1071–1078.

Pezzo, M. V., & Beckstead, J. W. (2008). The effects of disappointment on hindsight bias for real-world outcomes. Applied Cognitive Psychology, 22, 491–506.

Quinn, M., Campbell, K., & Keane, M. T. (2019). The unexpected unexpected and the expected unexpected: How people’s conception of the unexpected is not that unexpected. In Proceedings of the 41st annual conference of the cognitive science society (pp. 2627–2633). Montreal, QB: Cognitive Science Society.

Quinn, M. S., Campbell, K., & Keane, M. T. (2021). Do we “fear for the worst” or “hope for the best” in thinking about the unexpected?: Factors affecting the valence of unexpected outcomes reported for everyday scenarios. Cognition, 208, Article 105520.

Roese, N. J., & Olson, J. M. (1995). Outcome controllability and counterfactual thinking. Personality and Social Psychology Bulletin, 21, 620–628.

Roese, N. J., Smallman, R., & Epstude, K. (2017). Do episodic counterfactual thoughts focus on controllable action?: The role of self-initiation. Journal of Experimental Social Psychology, 73, 14–23.

Roese, N. J., & Vohs, K. D. (2012). Hindsight bias. Perspectives on Psychological Science, 7, 411–426.

Rosin, P., & Boyzman, E. B. (2001). Negativity bias, negativity dominance, and contagion. Personality and Social Psychology Review, 5, 296–320.

Schank, R., & Kass, A. (1990). Explanations, machine learning, and creativity. In Machine learning (pp. 31–48). Morgan Kaufmann.

Schank, R. C. (1986). Explanation patterns: Understanding mechanical and creatively. L. Erlbaum Associates.

Schank, R. C., Kass, A., & Riesbeck, C. K. (1994). Inside case-based explanation (1st ed.). Psychology Press. https://doi.org/10.4324/9781315807157

Taylor, S. E. (1991). Asymmetrical effects of positive and negative events: The mobilization-minimization hypothesis. Psychological Bulletin, 110, 67–85.

Teigen, K. H., & Keren, G. (2002). When are successes more surprising than failures? Cognition and Emotion, 16(2), 245–268.

Turner, J. E., Goodin, J. B., & Lokey, C. (2012). Exploring the roles of emotions, motivations, self-efficacy, and secondary control following critical unexpected life events. Journal of Adult Development, 19, 215–227.

Unkelbach, C., Alven, H., & Koch, A. (2020). Negativity bias, positivity bias, and valence asymmetries: Explaining the differential processing of positive and negative information. In Advances in experimental social psychology (pp. 115–187). Academic Press Inc.

Verma, J. P., & Verma, P. (2020). Determining sample size and power in research studies. Springer.

Weinstein, N. D., Harris, A. J. L., & Hahn, U. (1980). Unrealistic optimism about future life events. Journal of Personality and Social Psychology, 39, 806–820.