

Optimistic Update for Positive Life Events? An Unbiased Test

Neil Garrett & Tali Sharot

Affective Brain Lab, Department of Experimental Psychology, University College London,
London, UK

Abstract

A large body of research has documented a valence dependent asymmetry in belief updating. Specifically, participants update their beliefs to a greater extent when receiving desirable information compared to undesirable information. Here, we ask whether asymmetric belief updating is observed for predictions regarding everyday positive and negative life events. First, using simulations, we show that an artificial bias in updating would be observed if a skewed distribution of base rates is utilized without controlling for estimation errors. This artificial bias is flipped for positive and negative life events. We then go on to use normally distributed base rates, for which the simulation does not produce an artificial bias. Our human data reveal an optimistic update bias when predicting everyday life events and provides evidence that the pattern is similar regardless if one is estimating a positive or negative event.

The ability to anticipate the future helps us avoid harm and earn rewards. One would therefore expect the brain to have evolved learning mechanisms that support accurate, unbiased, foresight. However, when it comes to predicting what will happen tomorrow or next year, people tend to overestimate the likelihood of encountering positive events and underestimate the likelihood of encountering negative events (Armor & Taylor, 2002; Baker & Emery, 1993; Lovallo & Kahneman, 2003; Puri & Robinson, 2007; Sharot, 2011; Weinstein, 1980). For example, people underestimate their chances of getting divorced (Baker & Emery, 1993), being in a car accident or suffering from cancer (Weinstein, 1980). They also expect to live longer than objective measures would warrant (Puri & Robinson, 2007), overestimate their success in the job market (Wiswall & Zafar, 2015) and believe that their children will be especially talented (Weinstein, 1980). This tendency is known as the optimism bias (Sharot, 2012; Weinstein, 1980), and is one of the most consistent, prevalent and robust biases documented in psychology (Sharot, 2011, 2012).

An enduring puzzle is how do people maintain overly positive expectations in the face of reality. Contrary to standard theories of learning, which hold that people adjust their expectations when faced with disconfirming information (Pearce & Hall, 1980; Sutton & Barto, 1998), studies have shown a resistance to alter optimistic expectations in response to undesirable information (Gerrard, Gibbons, & Reis-Bergan, 1999). For instance, highlighting previously unknown risk factors for diseases is surprisingly ineffective at altering peoples' optimistic perception of their medical vulnerability (Weinstein & Klein, 1995). Recent findings, from our lab (Chowdhury, Sharot, Wolfe, Duzel, & Dolan, 2014; Garrett et al., 2014; Moutsiana et al., 2013; Moutsiana, Charpentier, Garrett, Cohen, & Sharot, 2015; Sharot, Kanai, et al., 2012; Sharot, Guitart-Masip, Korn, Chowdhury, & Dolan, 2012; Sharot, Korn, & Dolan, 2011) and others (Eil & Rao, 2011; Kuzmanovic, Jefferson, & Vogeley, 2015, 2016; Mobius, Niehaus, Niederle, & Rosenblat, 2012), provide a mechanistic explanation for these observations. Specifically, these studies show that people update their beliefs more in response to desirable information than to undesirable information (Eil & Rao, 2011; Sharot et al., 2011). For example, subjects are more likely to update beliefs when receiving 'good news' regarding their likelihood of encountering aversive events (such as learning the likelihood of being a victim of credit card fraud is lower than they thought) than when receiving 'bad news' (learning the likelihood of being a victim of credit card fraud is

greater than they thought) (Garrett & Sharot, 2014; Kuzmanovic et al., 2015, 2016; Sharot et al., 2011). Such asymmetry produces optimism that is relatively resistant to change.

Asymmetric updating of beliefs has also been shown to underlie the superiority illusion, by which people overestimate their positive characteristics and abilities and underestimate their negative characteristics and abilities (Hoorens, 1993; Kruger & Dunning, 1999). For instance, people update their beliefs more when receiving positive feedback about their intellectual abilities (Eil & Rao, 2011; Mobius et al., 2012), personality (Korn, Prehn, Park, Walter, & Heekeren, 2012) and physical traits (Eil & Rao, 2011) than negative feedback. Asymmetric updating has been reported both for positive characteristics (i.e. we update our beliefs regarding our *intelligence* to a greater extent when we receive a higher IQ score than we expected, relative to when we received a lower score (Eil & Rao, 2011)) and negative characteristics (i.e. we update our beliefs regarding our *clumsiness* to a greater extent when we learn people rated us as less clumsy than we had viewed ourselves, relative to when we learn people rated us as more clumsy (Korn et al., 2012)). In all these cases, desirable information is integrated into prior beliefs more readily than undesirable information, resulting in positively biased beliefs.

When it comes to estimating future events (rather than evaluating abilities and characteristics most (e.g. Baker & Emery, 1993; Kuzmanovic et al., 2015, 2016; Sharot et al., 2011) but not all (Weinstein, 1980; Wiswall & Zafar, 2015), studies have examined predictions specifically regarding aversive events (such as illness and violent acts). To our knowledge there has been one previous peer reviewed study that examined updating of beliefs regarding a future positive life event (Wiswall & Zafar, 2015). That study revealed that people update beliefs to a greater extent in response to evidence suggesting they are likely to earn more than they thought, relative to evidence suggesting they are likely to earn less. While that study suggests that optimistic updating of beliefs is indeed observed for positive life events, it is unknown whether biased updating for positive life events is greater, smaller, or equal than for negative life events. As unrealistic optimism consists both of overestimating the likelihood of positive events and underestimating the likelihood of negative events (Sharot, 2011; Weinstein, 1980),

the question of whether the same mechanism underlies both types of events equally is important for understanding optimism.

Here, we first describe two potential methodological pitfalls in studying updating for positive and negative life events utilizing the belief update task. We then proceed to present the results of the current study, which avoids such pitfalls.

Methodological Pitfall I: Obtaining Unreliable, Meaningless, Statistics for Positive Events.

In the original belief updating task (Sharot et al., 2011), participants are asked to estimate their likelihood of experiencing 80 aversive events in their lifetime (**first estimates**). They are then presented with the likelihood of these events in their population (**information**) and subsequently asked to estimate their likelihoods again (**second estimate**). Trials are then divided into ones where participants received **good news** (they learn that an aversive event is less likely than they thought) and trials where participants received **bad news** (they learn an aversive event is more likely than they thought). **Update** is calculated as the difference between the first and second estimate. When attempting to adapt this task to study positive life events researchers face potential confounds, which if ignored, will lead to invalid conclusions.

In particular, whilst validated statistics regarding the likelihood of encountering negative events in one's life-time are well documented (such as the likelihood of suffering different type of illness or being a victim of crime), statistics about the occurrence of positive life events are not readily available. This is problematic, as the belief update task requires the use of many trials and stimuli. Yet, it is practically impossible to find even 40 positive life events accompanied by validated statistics. One may be tempted to make up statistics for positive events to use in a study. However, the invalidity of such made up statistics will quickly become apparent to the subject, introducing a serious confound, which will make the exercise useless. For example, we are aware of a past attempt to examine updating for positive events where participants were asked the following questions (try and answer these yourself): 'How likely are you in your lifetime to: 'Attend a friend's birthday party?' 'Eat at your favorite restaurant?' 'Receive a present?' 'Have family visit you at Christmas?' 'Being told you are special?' Most people will have all those events happen to them over a lifetime, thus they are likely to enter estimates close

to 100%. This makes it impossible to measure update in a desirable direction (people cannot increase estimates beyond 100%). Moreover, participants are likely aware that no actual statistics exist for such questions. If participants are presented with base rates that are significantly lower than 100%, it would become even more apparent to them that the statistics are made up and thus should not be taken seriously.

Here, to generate meaningful stimuli for both positive and negative life events we altered the belief update task as follows; we asked participants to estimate their likelihood of encountering everyday life events in the *upcoming month*. We obtained the frequencies of such events by asking over 200 participants to report whether different common positive and negative life events occurred to them at least once in the past month. We then used this data to construct a list of base rates for each event (i.e. the likelihood of each life event occurring at least once in a given month in the sample). We then run the belief update task on an alternate, but demographically well-matched, set of participants, asking them to estimate their likelihood of encountering these events in the next month.

Methodological Pitfall II: Skewing the Distribution of Base Rate Artificially Produces a Flip for Positive Events.

When investigating biases in belief updating it is important to use a list of base rates that are normally distributed around a mean that sits mid-scale. For example, if a rating scale ranges from 5% to 95% the ideal mean would be 50% and all base rates should be normally distributed around this mean. Running simulations we show below that failing to ensure this creates spurious biases in updating (unless one controls for “estimation errors”, see below).

Consider four lists of base rate for life events; the first is skewed towards the bottom end (i.e. the majority of base rates are rare and fall below the midpoint of 50%), (**Figure 1a**); the second is skewed towards the top end (i.e. majority of base rates are common and fall above the midpoint of 50%, (**Figure 1b**); the third and fourth are normally distributed around 50%, (**Figure 1c and 1d**, this is the actual set we use in our study).

For each simulation we will randomly generate a **first estimate** for each trial for each “participant”. This will be a random integer drawn from a uniform discrete distribution between 5 and 95. We will then “present” our simulator the actual base rate for the event

on that trial (**information**) and generate a **second estimate** - a random integer between the first estimate and the information (also drawn from a uniform distribution). For example, for the question “how likely are you to go out of town for leisure in the upcoming month” our simulator may randomly select 10% (first estimate), it will then observe a base rate of 36% (information) and adjust its answer to a random number between 10 and 36, let’s say 30% (second estimate). Thus, the amount of update on this trial would be 20 (update is calculated such that positive numbers always indicate a move towards the base rate).

We run 1000 such simulations (i.e. “experiments”) for each set of base rates (**Figure 1**). If the data produced by a simulation results in biased updating, this will indicate that the bias is due to a statistical artifact (the result of the mathematical constraints of the task) and not to an asymmetry in human learning. If, however, the simulation produces no bias in updating, but a bias is observed for human data, this would suggest the bias is due to asymmetric learning not to a statistical artifact.

Our simulation clearly shows that when base rates are skewed, an artificial bias in belief updating is observed (**Figure 2a** and **2b**), but not when the base rates are normally distributed (**Figure 2c**). Importantly, when an artificial bias is detected it is observed in opposite directions for positive and negative life events creating a distinct “flip”. Specifically, when base rates are skewed towards the bottom end of the scale (rare events, **Figure 1a**), the simulation shows greater update for bad news than good news for positive life events (significant difference in 100% of our simulations, **Figure 2a**), while for negative life events update for good news is greater than bad news (significant difference in 100% of our simulations, **Figure 2a**). However, when the base rates are skewed towards the top end of the scale (common events, **Figure 1b**), the opposite flip is observed (**Figure 2b**); larger update for good news than bad news for positive life events (significant difference in 100% of cases) and the opposite pattern for negative life events (**Figure 2b**, significant difference in 100% of cases). Finally, when the base rates are *normally* distributed the simulation does not reveal asymmetric updating (**Figure 2c**, significant difference in only 5% of cases for positive and only 5% of cases for negative life events).

Why is an artificial bias produced for stimuli with a skewed distribution? The answer is relatively simple – if most base rates are skewed towards large numbers then on average there is more room to alter estimates when the first estimate is smaller than the base rate, than when it is larger. In other words the difference between the first estimate and the information given (this is known as the **estimation error**) will be larger when subjects receive good news for positive events and when they receive bad news for negative events. Thus, updates will be greater when information is “good” for positive events and “bad” for negative events, and vice versa when base rates are skewed towards low numbers. This statistical artifact, however, can be corrected by controlling for “estimation errors”. If in the simulations above we control for estimation errors in our analysis no bias is observed for any sets of base rates. This was tested by running an additional 20 simulations (10 for positive life events, 10 for negative life events, 20 participants per simulation) for each set of skewed base rates. For each set of simulated data we then conducted a repeat measures ANOVA with valence (good news/bad news) as a factor and entering the difference in estimation errors between good news and bad news as a covariate. When base rates were skewed towards the bottom end of the scale (**Figure 1a**) a valence effect between good news and bad news was not significant in 19 (95%) of these simulations. When base rates were skewed towards the top end of the scale (**Figure 1b**) a valence effect between good and bad news was no longer significant in all (100%) of these simulations.

Thus, to avoid false conclusions researchers should either use normally distributed base rates with a mean at the midpoint of the scale, control for estimation errors, or do both. We now proceed to describe a study, in which we examine how individuals integrate good and bad news into their beliefs about the likelihood of experiencing positive and negative life events, taking care to avoid the pitfalls above.

Experiment

Methods

I. Construction of stimuli

Participants. 300 participants located in the United States completed the survey on Mechanical Turk. As in past studies of the belief update task (Garrett & Sharot, 2014; Moutsiana et al., 2013, 2015), we excluded participants with a high Beck Depression Inventory (BDI) score indicating potential depression. 73 participants were excluded for having a BDI score greater than 11 (final sample = 227). Participants were all between the ages of 20 and 30 years of age (inclusive). Completion of the survey took approximately 25 minutes and participants were compensated for their time.

Task. The survey began by collecting basic demographic information from participants (age, level of education, marital status, employment status, monthly income) then 2 training examples were presented to familiarize participants with the task. Participants were then presented with 100 different commonly occurring life events for 3 seconds each. These were a mixture of positive events (for instance: “Discovered a new song you like”, “Laughed at a joke”) and negative events (for instance: “Had an argument with a family member”). Whilst the event was displayed on screen, participants were instructed to recall whether this event had happened to them in the past 4 weeks. They were then asked to indicate either (1) Yes: This event occurred to me at least once in the past 4 weeks; or (2) No: This event did not occur to me in the past 4 weeks. The order of these two options was counterbalanced. Participants had unlimited time to make a response (**Figure 3a**).

After completing the survey, participants rated each event on a 5 point likert scale (1=Very Negative; 2=Negative; 3=Neutral; 4=Positive; 5=Very Positive) and then completed the Beck Depression Inventory (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961) and Life Orientation Test Revised (Scheier, Carver, & Bridges, 1994). The survey was constructed and presented using web based survey service Qualtrics.

Analysis. For each event, the percentage of participants who indicated the event had occurred to them in the past month (out of all participants who completed the study) was calculated.

Event Selection: A subset of the events (n=54) were selected for use as stimuli. We selected positive and negative life events such that the range of each type of event (positive and negative) was normally distributed around a mean of 50%.

II. Belief Update Task

Participants. 200 participants located in the United States (age range 20 and 30) completed the survey on Mechanical Turk. 56 participants were subsequently excluded for having a BDI score above 11 indicating possible depression. A further 2 participants were excluded because the range of their responses were limited, resulting in zero trials in either the “good news” bin or “bad news” bin, making comparison impossible (final $n = 142$). There were no differences in age, education, income, marital status or employment status between this set of participants and participants that had completed the base rate survey used to construct the base rate statistics (all $P > 0.20$). Completion of the survey took approximately 1 hour and participants were compensated for their time.

Task. The survey began with an attention check designed to filter out participants that did not read instructions prudently. Then, demographic information was collected (age, level of education marital status, employment status, monthly income) and 2 training examples were run to familiarize participants with the task.

In the first session, on each trial participants were presented with 1 of 54 life events (see Supplementary Material for list of events) and asked to imagine the event happening to them in the month ahead. They were then asked to estimate how likely that event was to happen to them in the next 4 weeks. Participants were instructed to type in an estimate between 5% and 95%. Trials with responses outside this range were excluded from analysis. Participants were then shown the base rate statistic of the event happening in the next 4 weeks, which ranged from 15% to 85% (see **Figure 3b**). They were told that the statistic was the average likelihood of this event happening at least once in the next four weeks to someone from the same socioeconomic environment as them. In a second session, participants were asked to re-estimate how likely each event was to happen to them in the next 4 weeks.

After completion of the task, we tested participants' memory for the information presented. Participants were asked to recall the information previously presented of each event. Subsequently, participants were then asked to rate all life events according to how positive or negative they found them on a likert scale (1=very negative, 2=negative,

3=neutral, 4=positive, 5=very positive). They were also asked to rate past experience with each event (“Has this event happened to you before?” From 1 = never to 6 = very often).

Three quarters of participants (75%) also rated all events on: vividness (“How vividly could you imagine this event?” From 1 = not vivid to 6 = very vivid); familiarity (“Regardless if this event has happened to you before, how familiar do you feel it is to you from TV, friends, movies and so on?” From 1 = not at all familiar to 6 very familiar); and arousal (“When you imagine this event happening to you how emotionally arousing is the image in your mind?” From 1 = not arousing at all to 6 = very arousing). The scores of these are reported in Supplementary Table 2. Participants then completed the Beck Depression Inventory and the Life Orientation Test Revised.

The survey was constructed and presented using web based survey service Qualtrics.

Analysis. Life events were categorized as negative or positive for each participant individually according to their own evaluation. Specifically, events were classified as positive if the participant rated the event as 4 (positive) or 5 (very positive) in the ratings section of the task, and negative if rated as a 1 (very negative) or 2 (negative). Events with a neutral rating of 3 were excluded from the analysis.

For each type of event, participants could receive either “good news” or “bad news” depending on whether the participant initially overestimated or underestimated the probability of the event relative to the base rate (see **Table 1**). Specifically, if their first estimate was lower than the base rate presented, the information would be categorized as “good news” if the life event was positive and “bad news” if the life event was negative (column 1, **Table 1**). If their first estimate was higher than the base rate presented, the information would be categorized as “bad news” if the event was rated as a positive life event and “good news” if the event was rated as a negative life event (column 2, **Table 1**). Trials in which the initial estimate was equal to the statistic presented were excluded from subsequent analyses as these could not be categorized into either condition (less than one negative life event trial and less than one positive life event trial on average per participant).

Belief update was calculated for each trial and participant as the difference between first and second estimate. As done previously (Garrett et al., 2014; Moutsiana et al., 2013; Moutsiana, et al., 2015; Sharot, Kanai, et al., 2012) update was calculated such that positive scores indicate a move towards the base rate, regardless of event type and valence categorization, and negative scores a move away from the base rate. Mean update scores for each participant were entered into a 2 (good/bad news) by 2 (positive/negative life event) repeated measures ANOVA. Controlling for (1) the difference in memory for good news trials and bad news trials, both for positive and negative stimuli, (2) the difference in number of good news trials and bad news trials, both for positive and negative stimuli (3) the difference in absolute estimation errors for good news trials and bad news trials, both for positive and negative stimuli (estimation error = |first estimate – base rate|).

Results

We observed an asymmetry in updating, such that participants updated more in response to good news than bad news. This bias was not significantly different for positive and negative events. Specifically, entering update scores into a 2*2 repeat measures ANOVA with desirability of information (good/bad news) and life event type (positive/negative life event) as repeat factors (controlling for differences in memory, differences in number of trials and differences in estimation errors) revealed a main effect of desirability of information ($F(1,135)=6.29$, $p<0.02$), no effect of event type ($F(1,135)=0.08$, $p=0.78$) and no interaction ($F(1,135)=0.31$, $p=0.58$). The main effect of desirability was characterized by greater updating in response to good news compared to bad news for both positive life events (mean good news update=8.71, mean bad news update=7.79) and negative life events (mean good news update=10.66, mean bad news update=6.62). For negative life events this difference reached significance ($t(141)=4.00$, $p<0.01$), but did not for positive life events ($t(141)=1.25$, $p=0.22$). **Figure 4.**

Discussion

The current results show a valence dependent asymmetry in how participants update their beliefs, which is consistent with a large body of fast growing research (Eil & Rao, 2011; Korn et al., 2012; Kuzmanovic et al., 2015, 2016; Lefebvre, Lebreton, Meyniel, Bourgeois-Gironde, & Palminteri, 2016; Mobius et al., 2012; Sharot, 2011; Sharot & Garrett, 2016; Sharot, Guitart-Masip, et al., 2012; Sharot et al., 2011). Here, we observe

this asymmetry when people update their beliefs regarding their likelihood of experiencing every day events in an upcoming month. In particular, participants updated their beliefs to a greater extent when receiving desirable information regarding the likelihood of experiencing future life events in the next four weeks relative to undesirable information. Such an asymmetry in belief updating has been suggested as a mechanism supporting optimism (Sharot & Garrett, 2016).

Whilst unrealistic optimism has been previously reported for both positive (e.g. winning an award) and negative (e.g. divorce) life events (Weinstein, 1980), the extent of asymmetric updating for positive and negative life events has never been compared. The aim of this study was to compare optimistic updating (i.e. updating more when receiving desirable compared to undesirable information) for future *positive* life events with that for future *negative* life events. Our results show no statistical differences in the pattern of updating for positive and negative life events - in both cases participants updated their beliefs to a greater extent when receiving desirable information compared to undesirable information, regardless of whether the information was regarding a positive life event (such as: "Receive a complement about how you dress") or a negative life event (such as: "Hurt someone's feelings"). One should note that when examining each set of stimuli separately, a significant difference in updating for desirable and undesirable information emerged for aversive life events, but not for positive life events.

In our study, we avoid two potential pitfalls that could lead researchers to error when examining updating for positive and negative stimuli. First, we use a set of stimuli with base rates normally distributed around a mean at the midpoint of our rating scale. Using simulations, we show that utilizing a skewed distribution (without controlling for estimation errors) will produce an artificial flip in asymmetric updating for positive and negative life events. For base rates skewed towards high numbers (common base rates) one would artificially observe greater updating for bad news than good news for negative stimuli and the reverse for positive stimuli. For base rates skewed towards low numbers (rare base rates) one would artificially observe greater updating for good news than bad news for negative stimuli and the reverse for positive stimuli. However, when using a normal distribution our simulations show no bias, nor flip. This suggests that the asymmetric updating observed in our human data is organic rather than artificial.

Second, because valid base rates regarding the likelihood of positive events occurring during a person's lifetime are difficult to come by, we altered the belief update task. Specifically, we elicit real statistics for both positive and negative life events by sampling a large group of participants prior to conducting our study, asking them to indicate which of 100 different events did and did not happen to them in *the last four weeks*. This data provides us with base rates used to test a second group of participants, matched to the first, on the belief update task. The second set of participants is also asked to estimate the likelihood of events happening in the next four weeks, rather than in a lifetime. This procedure, avoids a host of different confounds that emerge when making up base rates for positive events. This includes making up base rates for positive events, but not negative events, and using nonsense questions such as "what is the likelihood that you will attend a friends' birthday party in your life time?" or "what is the likelihood that you will eat at your favorite restaurant in your life time?".

In sum, this study (1) extends the finding of an asymmetry in belief updating to everyday life events and (2) reveals a similar pattern of asymmetric updating for positive and negative life events.

Figure Legends

Figure 1

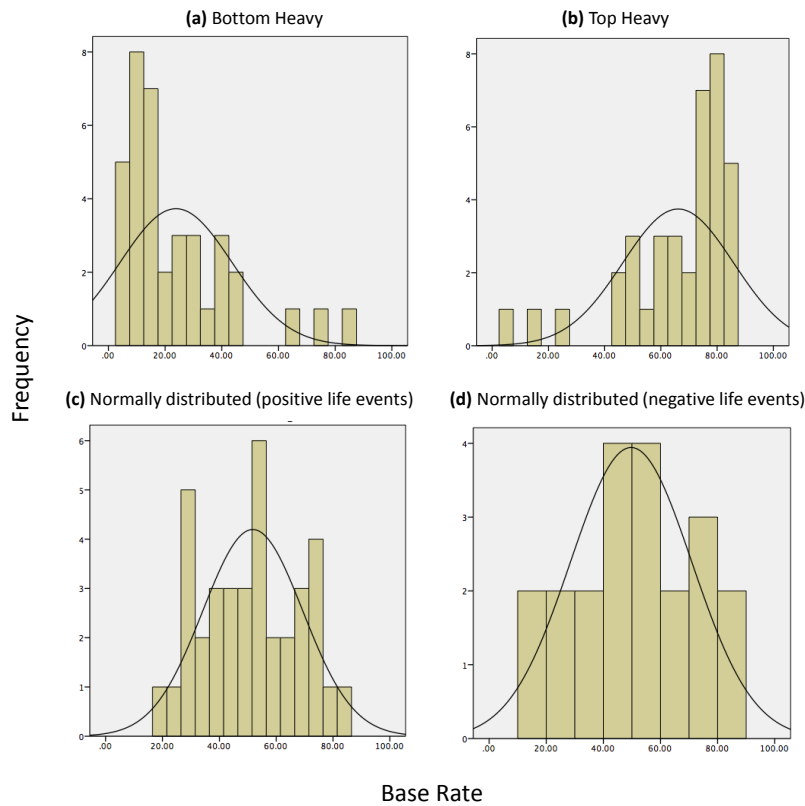


Figure 1: Histograms of base rates distributions used in simulations

Simulations were run using different distributions of base rates to examine the conditions under which an update bias is artificially produced. **(a)** Base rates are skewed towards the bottom end (i.e. the majority of base rates are rare). **(b)** Base rates are skewed towards the top end (i.e. majority of base rates are common). **(c, d)** Base rates used in the experiment were normally distributed around a mean of 50% both for **(c)** positive life events and **(d)** negative life events.

Figure 2

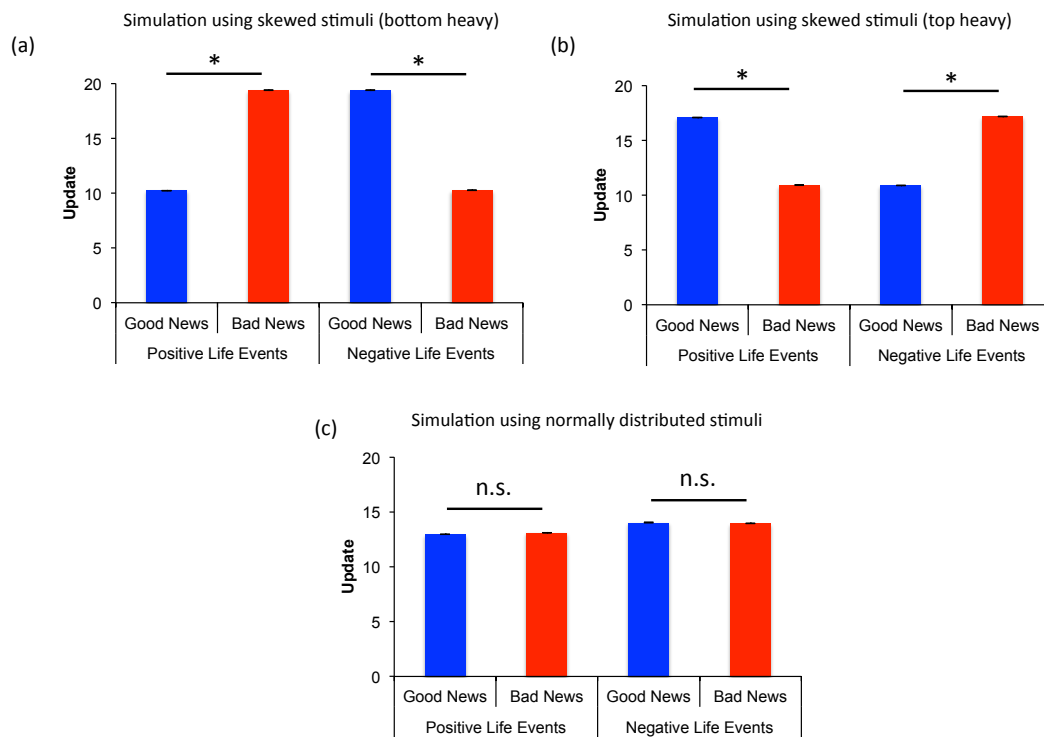


Figure 2: Simulations Results

For each group of base rates portrayed in Figure 1 we run simulations to examine patterns of updating. When base rates were skewed, an artificial update bias was revealed, which flips for positive and negative life events (these artificial biases are abolished when controlling for estimation errors). Simulation for **(a)** base rates that are skewed towards the bottom end of the scale (rare events) and **(b)** base rates that are skewed towards the top end of the scale (common events). **(c)** When base rates are normally distributed there is no artificial bias in updating.

Error bars represent SEM, * $p < 0.05$, two-tailed paired sample t -test.

Figure 3

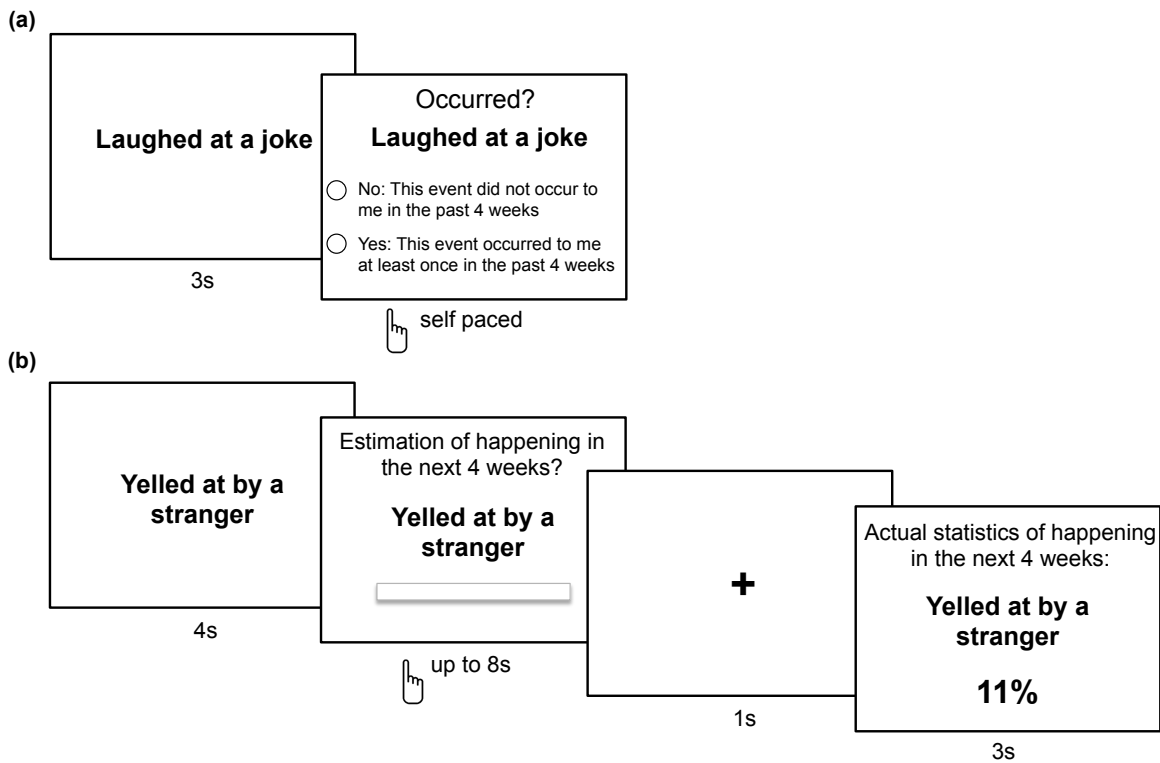


Figure 3: Task Design

(a) Construction of stimuli. Participants were presented with 100 commonly occurring positive and negative life events and were instructed to recall whether this event had happened to them in the past 4 weeks. Data was then used to construct a list of base rates.

(b) Update Bias Task. On each trial, participants were presented with a short description of one of 54 events and asked to estimate how likely this event was to occur to them. They were then presented with the average probability of that event occurring to a person like themselves (calculated from the previous task). In a second, session, participants were asked to re-estimate how likely the event was to occur to themselves. For each event an update term was calculated as the difference between the participant's first and second estimations, such that positive numbers indicate a move toward the base rate.

Figure 4

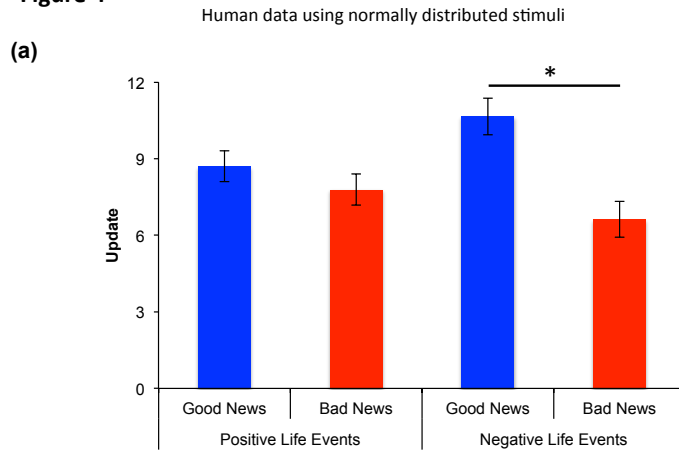


Figure 4: Biased Updating

An update bias is observed when using a normally distributed group of base rates. Updating is greater for good news compared to bad news.

*Error bars represent SEM, * $p < 0.05$, two-tailed paired sample t -test.*

Table 1: Categorization of events

	Initial Estimate < Base Rate	Initial Estimate > Base Rate
Positive Life Event (e.g. Get invited to a party)	Good News	Bad News
Negative Life Event (e.g. Have a headache)	Bad News	Good News

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Supplementary Table 1.

List of the stimuli used in the study and their respective base rates.

Base rates were generated from an independent set of participants tasked with reporting whether each event had happened to them at least once in the previous month.

Life events were classified as positive or negatives separately for each participant according to their own rating. Hence some events may be classified as positive for some participants but negative for others. There was, however, a high level of agreement among participants (interclass correlation coefficient = 0.75). Life events rated as neutral (i.e. neither positive nor negative) were not included in the analysis. On average 27 events were categorized as positive, 18 as negative and 7 as neutral.

Life Event	Base Rate %
<i>Attend a party</i>	45%
<i>Cook dinner for friends</i>	36%
<i>Donate money to a needy person or cause</i>	37%
<i>50 hours or more sleep in a single week</i>	56%
<i>Exercise at least twice in a week</i>	70%
<i>Finish reading a book</i>	41%
<i>Fix a broken possession</i>	39%
<i>Find or receive a gift of a dollar or more</i>	56%
<i>Get a haircut</i>	45%
<i>Get invited to a party</i>	58%
<i>Get taken out for dinner</i>	61%
<i>Have a sexual encounter that you enjoy</i>	69%
<i>Have a supervisor or teacher praise your work</i>	54%
<i>Have an out of town friend visit you</i>	30%
<i>Have your photo taken</i>	75%
<i>Invite a non-family member to a meal</i>	49%
<i>Learn a new skill related to work or school</i>	48%
<i>Make a purchase in excess of \$50 for your personal enjoyment</i>	65%
<i>Meet with your supervisor</i>	56%
<i>Participate in a game of sport</i>	29%
<i>Play a board game</i>	29%
<i>Play with a pet</i>	75%
<i>Run into an old friend that you haven't seen in a long time</i>	30%
<i>Receive a pay check</i>	81%
<i>Receive a complement about how you dress</i>	54%
<i>Shop for clothes</i>	56%
<i>Successfully teach someone a new skill or concept</i>	50%

<i>Take a day or more of annual leave</i>	19%
<i>Try out a new food or dish</i>	74%
<i>Try out a new hobby, craft, or sport</i>	31%
<i>Go out of town for leisure</i>	36%
<i>Wish a friend a happy birthday</i>	67%
<i>Win a competitive game of sport</i>	22%
<i>Burn something that you are cooking</i>	41%
<i>Embarrass yourself</i>	60%
<i>Family or friend get ill</i>	56%
<i>Find out that someone you know personally has died</i>	15%
<i>Get lost</i>	26%
<i>Get rejected by someone</i>	17%
<i>Get sick or suffered a physical illness</i>	41%
<i>Have a disagreement with a friend</i>	43%
<i>Have a headache</i>	82%
<i>Hear about a natural disaster</i>	85%
<i>Hear of a terrorist attack</i>	35%
<i>Hurt someone's feelings</i>	52%
<i>Ill one day because of overdrinking</i>	21%
<i>Received a phone call from a telemarketer</i>	52%
<i>Saw a dead animal/human</i>	56%
<i>Stay up past 2 AM for school or work</i>	40%
<i>Stuck in traffic</i>	71%
<i>Teased at/made fun of</i>	35%
<i>Get lied to</i>	60%
<i>Receive a utility bill</i>	78%
<i>Clean the bathroom</i>	78%

Supplementary Table 2.

Additional ratings provided by 75% of the participants. Prior Experience rated by all participants.

	Positive Life Events, mean (SD)		Negative Life Events, mean (SD)	
Ratings	Good news	Bad news	Good news	Bad news
Subjective Scales Questionnaire: 1 = low to 6 = high				
Familiarity ^{L, V*L}	4.68 (0.77)	5.11 (0.70)	4.75 (0.84)	4.35 (0.99)
Vividness ^{L, V*L}	4.42 (0.82)	4.83 (0.65)	4.34 (0.84)	3.97 (0.99)
Emotional arousal ^{V, L, V*L}	3.75 (0.91)	3.92 (1.00)	3.89 (0.83)	3.10 (1.27)
Prior experience ^{V, L, V*L}	3.80 (0.81)	4.51 (0.68)	3.75 (0.84)	3.18 (0.91)

^L Main effect *life event* valence (positive/negative) $p < 0.05$

^V Main effect information *valence* (*good news/bad news*), $p < 0.05$

^{V*L} Interaction (valence by life event), $p < 0.05$

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