Extreme cognitions are associated with diminished ability to use disconfirming evidence

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Abstract

Objectives An Integrative Cognitive Model of mood swings and bipolar disorder proposes that cognitive styles characterised by extreme self-referent appraisals of internal states (e.g., *'If I have a bad night's sleep it means that I am about to have a breakdown'*) interfere with mood regulation. The aim of this study is to determine whether strong endorsement of such appraisals is predicted by a diminished ability to access disconfirming counterexamples.

Design We examined whether the ability to access two different categories of counterexample (known as Disabling Conditions and Alternative Causes) would predict endorsement of extreme appraisals (measured by the Hypomanic Attitudes and Positive Predictions Inventory; HAPPI) and mania risk (measured by the Hypomanic Personality Scale; HPS).

Method A non-clinical sample of 150 students completed the HAPPI, the HPS and a conditional reasoning task that indexed the ability to access Disabling Conditions and Alternative Causes. Current mood was controlled for using the Internal States Scale.

Results The ability to make use of *disabling* counterexamples during the reasoning task was inversely related with scores on the HAPPI (r= -.19, p<.05); participants that were less able to make use of disabling counterexamples endorsed extreme self-referent appraisals to a greater extent. There was no association between the use of alternative cause counterexamples and the HAPPI, and no association between either measure of counterexample generation and the HPS.

Conclusions A diminished ability to use disconfirming evidence when reasoning about the world may reinforce problematic cognitive styles such as extreme, personalised appraisals of experience, which can interfere with mood regulation.

Key words: Reasoning bias; Conditionals; Beliefs; Counterexamples; Bipolar Disorder; Appraisals; Hypomanic Personality

Practitioner points

- Problematic cognitive styles such as extreme, personalised appraisals of experience may be reinforced by the inability to produce or access evidence that disconfirms these maladaptive beliefs.
- This reasoning bias may be associated with cognitive styles underlying psychopathology.
- There may be clinical utility in exploring the use of disabler generation in psychological interventions, to help disconfirm maladaptive beliefs.

Extreme cognitions are associated with diminished ability to use disconfirming evidence

An Integrative Cognitive Model of mood swings and bipolar disorder (ICM; Mansell, Morrison, Reid, Lowens & Tai, 2007a) proposes that cognitive styles characterised by extreme self-referent appraisals of internal states (e.g., mood and activation) interfere with effective mood regulation among individuals with bipolar disorder, as well as in the general population. According to the ICM, these self-referent appraisals can be positive or negative; for example, "*If I feel excited, then the world is full of unlimited opportunities*" or, conversely, "*If I feel excited, then I am about to have a breakdown*". These online (in-the-moment) appraisals of internal state are informed by latent metacognitive beliefs and are measured by the theory-driven Hypomanic Attitudes and Positive Predictions Inventory (HAPPI; Mansell, 2006; Dodd, Mansell, Morrison & Tai, 2010). The HAPPI is made up of 61 statements describing self-referential and extreme appraisals about internal states (see example A below).

a) *If I have a bad night's sleep[then] it means that I am about to have a breakdown*

According to the ICM, those who strongly endorse such statements are less able to effectively regulate their mood, a key characteristic of bipolar disorder (see Mansell et al, 2007a). Bipolar disorder is characterised by a heterogeneous symptom profile, including mood states that are elevated, irritable, depressed and anxious. The ICM and research supporting its clinical utility stresses that vulnerability to mood swings arises from having extreme appraisals that are multiple, and conflicting. It is this push and pull between conflicting interpretations of the same internal states that underlies the multifaceted and dynamic nature of bipolar disorder, as well as mood swings in non-clinical groups. This has been supported by research reporting associations between extreme self-referent appraisals of internal state and hypomanic personality traits (thought to confer risk of mania) and with both high and low mood in non-clinical populations (Dodd, Mansell, Morrison & Tai, 2011a; Dodd, Mansell, Bentall, & Tai, 2011b). Extreme appraisals are also associated with mood and functioning in people with diagnosed bipolar disorder (Dodd, Mansell, Morrison & Tai, 2011c; Fletcher, Parker & Manicavasgar, 2014). These individuals endorse extreme appraisals to a greater extent than those with unipolar depression and non-clinical controls (Alatiq, Crane, Williams & Goodwin, 2010; Kelly, Mansell, Wood, Alatiq, Dodd & Searson, 2011; Mansell, 2006).

In this paper we propose that the degree to which extreme self-referent appraisals are endorsed is related to individual differences in the more general cognitive ability to access latent, disconfirming evidence (i.e., counterexamples retrieved from memory). The spontaneous activation of counterexamples should reduce the extent to which extreme appraisals are endorsed by weakening the cause-effect link. For instance, an individual might be less likely to endorse example A (see above) if

they can readily access beliefs that disconfirm this appraisal (e.g., *"I have had a bad night's sleep many times in the past and not had a breakdown"; "I would seek help before having a breakdown"; "I am a resilient person"* and so on).

In support of this hypothesis, a number of studies in cognitive psychology have shown that the endorsement of everyday cause-effect statements is influenced by the availability of implicit, disconfirming counterexamples. For example, Cummins (1995; see also Cummins, Lubart, Alksnis, & Rist, 1991) showed that people are less likely to endorse logical inferences from cause and effect statements that have many implicit counterexamples, such as example B, relative to statements that have few implicit counterexamples, such as example C.

b) *If John studied hard, then he did well on the test.* [Many Counterexamples]
c) *If Joe cut his finger, then it bled.* [Few Counterexamples]

The two most common types of counterexample are known as Disabling Conditions and Alternative Causes. Disabling conditions are latent factors that might prevent an effect even though the cause occurs (e.g., John studied the wrong topic; John was ill and missed the test). Alternative causes are additional latent causes that might result in the same effect (e.g., John cheated; the test was very easy). Disablers cast doubt on the sufficiency of a cause to bring about an effect; whereas alternatives cast doubt on the necessity of a specific cause (Cummins, 1995; Sellen, Oaksford & Gray, 2005).

While the aggregated results from non-clinical samples show that people are generally able to access and use implicit counterexamples (e.g., Cummins, 1995), these findings overlook what might be important individual differences. This is particularly relevant as Harvey, Watkins, Mansell and Shafran (2004), in a review of the cognitive and behavioural processes across psychological disorders, have questioned whether such experiences are related to a generally reduced ability to access and use disconfirming evidence. Indeed, theory and evidence suggests that a diminished ability to access and use disconfirming evidence is associated with aspects of psychopathology among both clinical and non-clinical samples (Galbraith & Manktelow, 2015; Sellen et al., 2005).

The current study

The evidence reviewed above suggests that the degree to which extreme appraisals of internal state are endorsed may be influenced by access to implicit, disconfirming counterexamples. We hypothesise that people with a generally diminished ability to access latent counterexamples will endorse extreme self-referent appraisals to a greater extent than those who routinely access such disconfirming evidence. Specifically, we predict that a diminished ability to access *disabling*

counterexamples will be associated with greater endorsement of extreme self-referential appraisals. Disabling counterexamples can weaken any given cause and effect relationship by creating doubt about the *sufficiency* of a stated cause (e.g., having a bad night's sleep) to bring about an effect (e.g., having a breakdown); the more readily those disabling counterexamples are accessed, the more doubt that is created. An impaired ability to identify disabling conditions to self-referent appraisals, should therefore lead to greater endorsement of those appraisals. In contrast, we predict no such association between the ability to generate alternative causes and the endorsement of extreme self-referential appraisals. This is because alternative causes provide an alternative way to achieve the same outcome (i.e., they influence the perceived necessity of a cause), but should not influence the perceived strength of a given cause and effect relationship (Cummins, 1995).

To reveal individual differences in the ability to utilise implicit counterexamples we employed a conditional reasoning task developed by Cummins (1995). This task requires participants to generate logical inferences from everyday statements such as examples B and C (above), which vary in the number of latent alternative causes and the number of latent disabling conditions (see method section for more details). This task was used by Sellen et al. (2005) to reveal an association between one aspect of schizotypy (Impulsive Nonconformity) and the tendency to overlook latent counterexamples in a non-clinical sample of students. To do this, they calculated a Disabling Conditions Index and an Alternative Causes Index for each participant in their analogue student sample. These indexes measured the ability of participants to make use of alternatives and disablers, respectively. In the study reported below we examine whether individual differences in the ability to use alternatives and disablers (as measured by the Alternative Causes Index and the Disabling Conditions Index) is associated with the extent to which extreme appraisals are endorsed (as measured by the HAPPI).

In line with Sellen et al. (2005), a non-clinical sample was recruited. Continuum conceptualisations of mental illness argue that psychological distress lies on a continuum with every day experiences, and that the same processes underlie clinical and non-clinical manifestations, as opposed to more categorical conceptualisations of mental illness (Walsh, Royal, Brown, Barrantes-Vidal & Kwapil, 2012; Kinderman, Read, Moncrieff & Bentall, 2013). The ICM (Mansell et al., 2007) was developed to explain mood dysregulation in non-clinical populations as well as bipolar disorder, and in support of this, previous evidence has demonstrated that extreme appraisals of internal states are associated with both high and low mood, as well as mania risk, in non-clinical populations (Dodd et al., 2011a, b; Dodd et al., 2010). It is hypothesised that participants who strongly endorse extreme appraisals (as measured by the HAPPI) will also have the tendency to not use implicit *disabling* counterexamples. In addition, given that the endorsement of extreme appraisals is associated with mania risk (Dodd et al., 2010, 2011b) we sought to examine whether impaired counterexample generation contributed to this risk, as measured by the Hypomanic Personality Scale (HPS; Eckblad & Chapman, 1986). Because

current mood state is often associated with the endorsement of beliefs about internal states (Dodd et al, 2011a-c), we measured and controlled for this in our analyses.

Method

Participants

An opportunity sample of 150 students (128 female; mean age 20.3 years) completed this web-based study. The majority were psychology students from University *X* (n=128) and took part for course credit. The remainder were volunteers from University *Y* and received no incentive. A further 49 volunteers (43 female; mean age 19.9 years) began the study, but withdrew by closing their web browser before completion. All of these individuals failed to provide any data on at least one of our four measures, with most withdrawing at an early stage in the protocol. Data from these withdrawn participants were excluded.

Materials

Internal State Scale (ISS) (Bauer et al., 1991). To control for the effect of current mood on reasoning and questionnaire responses, the ISS was completed by all participants. The four subscales of the ISS measure different internal states: Activation, e.g. '*Today my thoughts are going fast'* (Cronbach's α =.80); Perceived Conflict e.g., '*Today I feel irritable*' (α =.75); Depression e.g., '*Today I feel depressed*' (α = .81); and Well-being, e.g., '*Today I actually feel great inside*' (α =.75). Participants rate to what extend they feel the way described in each of 15 items on a visual analogue scale from 0-100. The scale has been associated with clinician-rated measures of symptoms (Bauer et al., 1991).

Conditional inference task (Cummins, 1995). This is the task originally developed by Cummins (1995) and used by Sellen et al. (2005) to examine the link between counterexample generation and schizotypy. The latter used data from this task to calculate an Alternative Causes Index and a Disabling Conditions Index. These indexes measure the ability of participants to make use of latent alternative causes and latent disabling conditions.

Participants were presented with 16 '*if…then…*' conditional statements (e.g., *"If the trigger was pulled, then the gun fired"*). Cummins (1995) collected pre-test data in which participants were asked to explicitly identify alternative causes and disabling conditions for each statement. These data were used to group each of the statements into one of four categories i) 'many alternatives, many disablers', ii) 'many alternatives, few disablers' iii) 'few alternatives, many disablers' iv) 'few alternatives, few disablers' (see Appendix 1 for full list of items and their pre-test ratings). An example of a latent

disabling condition might be that the gun was not loaded, whereas an example of an alternative cause might be that the gun was faulty.

Each of the 16 statements was presented in four different contexts. These contexts contained the conditional statement, a minor premise (i.e., a fact relating to the conditional statement) and a conclusion that corresponded to each of four logical inference types (known as Modus Ponens, Modus Tollens, Denial of the Antecedent and Affirmation of the Consequent). Figure 1 illustrates the four types of inference that participants were asked to evaluate for each of the 16 items. Participants rated 64 permutations in total (16 statements x 4 inference types). They were asked to rate how sure they were that the given conclusion could be drawn, using a seven point scale anchored at -3 (very sure I CANNOT draw this conclusion), zero (Can't tell), and +3 (very sure I CAN draw this conclusion).

FIGURE 1 ABOUT HERE

From the reasoning task data we calculated a Disabling Conditions Index and an Alternative Causes Index for each participant, using the formula devised by Sellen et al. (2005). The Disabling Conditions Index is the sum of acceptance ratings for all MP and MT inferences with many disabling conditions subtracted from the sum of acceptance ratings for all MP and MT inferences with few disabling conditions. Higher scores on this index mean that participants are more able to access and use implicit disablers. Likewise, the Alternative Causes Index is the sum of all acceptance ratings on AC and DA inferences with many alternative causes subtracted from the sum of all acceptance ratings on AC and DA inferences with few alternative causes. Again, higher scores on this index mean that participants are more able to access implicit alternative causes.

Hypomanic Personality Scale (HPS) (Eckblad & Chapman, 1986). The HPS is commonly used in research as a measure of mania, or bipolar disorder, risk. Forty eight true-false items relate to a personality style characterised by traits such as self-confidence, ambition, and emotional responsiveness (e.g., '*In unfamiliar surroundings, I am often so assertive and sociable that I surprise myself*', '*I seem to be a person whose mood goes up and down easily*'). It has been associated with future diagnosis of bipolar disorder (Kwapil, Miller, Zinser, Chapman, Chapman, & Eckblad, 2000), bipolar symptomatology (Walsh et al., 2012) and psychological processes relevant to bipolar disorder (Kwapil, Barrantes-Vidal, Armistead, Hope, Brown, Silvia, & Myin-Germseys, 2011). In our sample, Cronbach's α was .73.

Hypomanic Attitudes & Positive Predictions Inventory (HAPPI; Mansell, 2006; adapted by Dodd et al., 2010). The extended 61-item HAPPI (Dodd et al., 2010) measures positive and negative extreme,

self-referent appraisals of internal states, primarily activated states e.g., '*When I feel good, I know that whatever I do, I could do no wrong*', '*When my moods drive upwards there is nothing I can do about it*'. The majority of these statements are expressed in the conditional form '*if p, then q*' or '*when p, then q*'. Participants endorse how much conviction they have in each of these 61 beliefs on a visual analogue scale from 0-100. Responses to this measure were used to calculate an overall mean HAPPI score (Cronbach's $\alpha = 0.96$) and six subscales, named Increasing Activation to Avoid Failure ($\alpha = .73$), Loss of Control ($\alpha = .80$), Regaining Autonomy ($\alpha = .80$), Social Self-Criticism ($\alpha = .89$), Success Activation ($\alpha = .85$) and Grandiose Appraisals ($\alpha = .74$).

Procedure

Approval was granted by the Department of Psychology Research Ethics Committee at University *X* and the University *Y* Research Ethics Committee. The study was run entirely online using Qualtrics survey software. Volunteers were provided with a URL for the study and completed it at their convenience. Each participant gave informed consent and then completed the ISS, conditional inference task, HPS and HAPPI in that order. Items on the ISS, HPS and HAPPI were presented in the same order to each participant. Each participant saw the 64 items of the reasoning task in a different random order.

Statistical Analysis

We aimed to find out if the Disabling Conditions Index and Alternative Causes Index would predict the endorsement of extreme appraisals (as measured by the HAPPI) and mania risk (as measured by the HPS), while controlling for current mood (measured by the ISS) and potentially confounding demographic factors. To identify potential confounding variables, independent samples t-tests were used to assess gender differences in the outcome variables, and Pearson's correlations to check relationships between outcome variables and age. In order to examine the association between counterexample generation and extreme appraisals of internal state we first used Pearson's correlations to examine the extent to which the HAPPI and HPS correlated with our two measures of counterexample generation (the Disabling Conditions Index and Alternative Causes Index). We then followed up significant correlations using hierarchical multiple regression in order to reveal the unique contribution of counterexample generation to the variance in extreme appraisals of internal state, while controlling for current mood and demographic factors. These potential confounding variables were entered in the first step, and our measure of counterexample generation entered in the second step.

Results

Descriptive statistics

A missing values analysis revealed a limited amount of missing data (<0.1% of questions were unanswered, with a maximum of 1.3% missing from any one item). Missing data points were imputed using Expectation Maximisation. Table 1 shows the descriptive statistics for all variables. Mean HAPPI score was comparable to those previously published for students (Dodd et al, 2011b reported a mean of 29.97 and a standard deviation of 12.85), and lower than those of a group diagnosed with bipolar disorder (Dodd et al, 2011c reported a mean of 41.96 and a standard deviation of 19.41). Likewise, the mean HPS total score for our sample was comparable to previous studies that have recruited a student sample (Dodd et al, 2011b reported a mean of 15.98 and a standard deviation of 8.23). When exploring demographic variables, age was significantly correlated with the HAPPI mean score (r = -.16, p = .045) but not with HPS total score (r = -.08, p=.316). There were no gender differences on either the HAPPI mean score $t(148)$ = -.33, p =.741) or the HPS total score $t(148)$ = -.24, p =.81).

TABLE 1 ABOUT HERE

Counterexample generation and extreme appraisals

Results from bivariate correlations are displayed in Table 2. These revealed that the Disabling Conditions Index was negatively correlated with the HAPPI mean score and five out of six of the HAPPI subscales; meaning that increased endorsement of extreme appraisals was associated with a decrease in the use of disabling counterexamples. There was no relationship between the Alternative Causes Index and the HAPPI mean or any of its subscales. The Activation, Conflict and Depression subscales of the ISS were significantly correlated with the HAPPI mean, as was the HPS (r = .481, p=<.0001). There was also no relationship between either of the counterexample generation measures and the HPS.

TABLE 2 ABOUT HERE

To further explore the significant relationship between the HAPPI and the Disabling Conditions Index, a hierarchical multiple regression was conducted. This allowed us to reveal the amount of unique variance explained by the Disabling Conditions Index after potential confounding variables were first included in the model. The dependent variable was HAPPI mean score. In step one, we controlled for potentially confounding factors that were correlated with HAPPI mean score (ISS Conflict, ISS Depression, ISS Activation, HPS total score, and Age). In step two we additionally entered the Disabling Conditions Index (see Table 3).

Step one accounted for 38.5% of the variance in the HAPPI mean score (R^2 =.385, p <.001). The addition of the Disabling Conditions Index in step two significantly increased the amount of variance explained by our model (R^2 change = .03, p < .01). Table 3 shows that in step one ISS Depression and HPS had a positive unique association with mean score on the HAPPI. In step two, ISS Depression and HPS continued to have a positive unique association, whereas the Disabling Conditions Index had a negative unique association with mean score on the HAPPI.

TABLE 3 ABOUT HERE

Discussion

The Integrative Cognitive Model of mood swings and bipolar disorder (Mansell et al., 2007a) proposes that cognitive styles characterised by extreme self-referent appraisals of internal state interfere with effective mood regulation. In this study, those who strongly endorsed extreme appraisals tended to be less able to access disabling counterexamples, even when controlling for current mood, mania risk and age. Disabling counterexamples cast doubt on the sufficiency of a cause to bring about an effect. Respondents with high scores on the HAPPI displayed a generalised tendency to overlook these disabling conditions during the reasoning task. In other words, they were less willing or less able to access disconfirming evidence (c.f. Harvey et al., 2004). Therefore, the data presented above provide preliminary evidence that strong endorsement of extreme self-referent appraisals (e.g., *"If I have a bad night's sleep it means that I am about to have a breakdown"*) is associated with a generally diminished ability to access latent disabling conditions. The size of the effect was small, but this reasoning bias may be one of the mechanisms by which extreme appraisals are initially accepted, and why they persist.

There was no such association between scores on the HAPPI and the Alternative Causes Index. This may be because alternative causes do not disconfirm extreme appraisals to the same extent as disabling conditions. When considering example A (see Introduction), thinking of alternative causes for having a breakdown is less likely to diminish belief in this statement than thinking of reasons that actively disable the cause and effect relationship. However, it is possible that alternative causes may play a role in the initial generation of extreme appraisals, which is a process not measured by the HAPPI. For example, people may rapidly reject extreme appraisals of an internal state change if they are able to think of many alternative appraisals.

Likewise, neither of the reasoning indexes were associated with mania risk (as measured by the HPS). As mentioned above, it may be that these reasoning processes play a role in the development of cognitive styles relevant to mood dysregulation, rather than directly underlying risk of mood dysregulation *per se*. However, it is important to note that in previous research the HAPPI has explained more unique variance in bipolar mood symptoms than the HPS (Dodd et al, 2011b), so it may be that this cognitive style is actually more predictive of bipolar disorder than hypomanic personality.

Limitations and future directions

Of course, further research is necessary to disentangle these processes. Firstly, the reasoning task focused on everyday cause and effect statements and did not directly measure the ability to form counterexamples to extreme appraisals. It would be interesting to see if the null finding for mania risk was still present when using more emotionally-salient stimuli for conditional inferences, or if a mood induction was used prior to undertaking the reasoning task. Secondly, while we argue that using less disconfirming evidence may play a role in the development of extreme appraisals, further research is required to determine the direction of this relationship. From our theoretical perspective, impairment in the *general* cognitive ability to access disconfirming evidence should influence the more *specific* evaluation of extreme appraisals. However, further research is required to evaluate the possibility of a bi-directional relationship.

There is also an important question about whether a lower score on the disabling conditions index reflects an *inability* to use disconfirming evidence or a reduced *willingness* to use disconfirming evidence, and whether this is an implicit or explicit process. To help with these points, links with related cognitive mechanisms, such as episodic memory, could also be explored. For example, are people with greater endorsement of extreme appraisals able to generate disablers for these types of belief about internal states if directly asked? The ICM (Mansell et al, 2007) suggests that the metacognitive beliefs that inform appraisals of internal states are themselves formed through life experiences, including life events dependent on mood. In this non-clinical sample, this could be (for example) the experience of being shunned by friends after being too hyper; in Bipolar Disorder, this could be something as distressing as hospitalisation due to a manic episode. If there are few counterexamples stored in memory to refute appraisals such as '*If I feel excited, I'm going to have a breakdown*', this would help to perpetuate such appraisals.

Finally, this study recruited a non-clinical sample of individuals, who are less likely to have experienced significant highs or lows of mood and attached extreme and self-referent meaning to these experiences; on average, this group had lower endorsement of extreme appraisals of internal states than individuals with bipolar disorder. To optimise applicability to clinical interventions, it is

vital to determine if these findings extend to clinical samples. Clinical applications of the ICM (Mansell, 2007; Mansell, Morrison, Reid & Lowens, 2007b; Searson Mansell, Lowens & Tai, 2011) highlight the importance of showing service users how their extreme appraisals are influencing their behaviour and exacerbating their mood difficulties. Dimished use of disablers may interfere with the ability to disconfirm maladaptive beliefs or generate normalising appraisals, meaning individuals are less able to step out of the following cycle: extreme appraisal of internal state change – behavioural response – further internal state change – further self-referent extreme appraisal. There may therefore be clinical utility in further exploring the use of disabler generation in therapeutic contexts, including cognitive-behavioural therapy (cf. Balzan, Woodward, Menon & Moritz, 2015). If service users are able to explicitly identify disabling conditions when they experience an extreme appraisal of internal state, then it may reduce the likelihood of these appraisals being accepted and maintained.

Conclusion

The data we report suggest that extreme appraisals of internal state may be driven to some extent by a generally diminished ability to access disconfirming evidence. The ability to use disabling information appears to be at least one of the cognitive processes that accounts for variation in the endorsement of extreme appraisals. This novel finding has implications for the Integrative Cognitive Model of mood swings and bipolar disorder and may have some clinical utility. Indeed, finding that conviction in beliefs and appraisals that are extreme and personalised may be fuelled by a more general reasoning bias has implications for the study of maladaptive cognitive styles in general.

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Appendix 1

Conditional statements used in the reasoning task. Pre-test data, taken from Cummins (1995), shows the mean number of alternative causes and disabling conditions that were generated by participants for each item.

Conditional Statement	Mean number of alternative causes	Mean number of disabling conditions
Many alternative causes, many disabling conditions		
1. If fertilizer was put on the plants, then they grew quickly.	4.2	3.4
2. If the brake was depressed, then the car slowed down.	4.7	3.1
3. If John studied hard, then he did well on the test.	3.9	4.4
4. If Jenny turned on the air conditioner, then she felt cool.	3.9	3.6
Many alternative causes, few disabling conditions		
5. If Alvin read without his glasses, then he got a headache.	4.4	1.5
6. If Mary jumped into the swimming pool, then she got wet.	4.2	2.3
7. If the apples were ripe, then they fell from the tree.	4.2	1.9
8. If water was poured on the campfire, then the fire went out.	3.8	2.2
Few alternative causes, many disabling conditions	2.0	2.9
9. If the trigger was pulled, then the gun fired.	1.8	2.7
10. If the correct switch was flipped, then the porch light went on.	1.6	3.7
11. If the ignition key was turned, then the car started.	1.9	3.7
12. If the match was struck, then it lit.		
Few alternative causes, few disabling conditions		
13. If Joe cut his finger, then it bled.	0.7	2.1
14. If Larry grasped the glass with his bare hands, then his fingerprints were on it.	0.8	1.9
15. If the gong was struck, then it sounded.	2.5	2.0
16. If the doorbell was pushed, then it rang.	2.3	2.5

Figure and Table captions

Figure 1: Example of the four types of inference that participants were asked to evaluate for each of the 16 conditional statements. Following each Statement and Fact they were asked to rate how sure they were that the given Conclusion could be drawn, using a seven point scale.

Table 1: Descriptive statistics for the HAPPI subscales, ISS subscales, HPS and counterexample indexes.

Table 2: Correlation between our outcome variables (HPS and HAPPI) and measures of counterexample generation, current mood and age.

Table 3: Table 3: Hierarchical regression model with HAPPI mean score as the dependent variable (β coefficients are standardised).

Figure 1

Figure 1: Example of the four types of inference that participants were asked to evaluate for each of the 16 conditional statements. Following each Statement and Fact they were asked to rate how sure they were that the given Conclusion could be drawn, using a seven point scale.

Inference	**Statement**	**Fact**	**Conclusion**
Modus Ponens	"*If the trigger was pulled, then the gun fired"*	The trigger was pulled.	Therefore, the gun fired.
Modus Tollens	"*If the trigger was pulled, then the gun fired"*	The gun did not fire.	Therefore, the trigger was not pulled.
Denial of the Antecedent	"*If the trigger was pulled, then the gun fired"*	The trigger was not pulled.	Therefore, the gun did not fire.
Affirmation of the Consequent	"*If the trigger was pulled, then the gun fired"*	The gun fired.	Therefore, the trigger was pulled.

Table 1

Table 1: Descriptive statistics for the HAPPI subscales, ISS subscales, HPS and counterexample indexes.

Variable	Mean	SD	Min.	Max.
HAPPI				
HAPPI mean	32.16	13.63	1.31	69.18
Increasing activation to avoid failure	36.88	16.69	0	78.57
Regaining autonomy	29.07	19.59	0	78
Social self-criticism	20.27	16.96	0	77.78
Success activation and triumph over fear	40.88	17.34	0	82.22
Loss of control	39.97	19.36	0	81.67
Grandiose appraisals of ideation	31.08	17.61	0	74
ISS				
ISS Conflict	166.16	91.82	10	489
ISS Depression	59.29	49.61	0	200
ISS Wellbeing	153.97	54.68	5	288
ISS Activation	180.95	97.50	9	445
HPS				
HPS total	16.03	7.90	3	39
Counterexample indexes				
Disabling Conditions Index	6.54	9.95	-14	38
Alternative Causes Index	23.67	18.26	-15	65

Table 2

Table 2: Correlation between our outcome variables (HPS and HAPPI) and measures of counterexample generation, current mood and age.

			HAPPI subscales					
	HPS	**HAPPI mean**	Increasing Activation	Loss of Control	Regaining Autonomy	Social Self-Criticism	Success Activation	Grandiose Appraisals
Disabling Conditions Index	-.121	-.190*	-.177*	-.098	-.162*	-.175*	-.210**	-.184*
Alternative Causes Index	-.028	-.079	-.104	.104	-.073	-.095	-.073	-.122
ISS Conflict	.131	.388**	.399**	.348**	.393**	.408**	-.011	.087
ISS Depression	-.033	.333**	.432**	.332**	.324**	.368**	-.127	.027
ISS Wellbeing	.224**	-.100	-.245**	-.142	-.150	-.194*	.310**	.128
ISS Activation	.485**	.450**	.450**	.430**	.394**	.315**	.249**	.280**
Age	-.082	-.164*	-.142	-.129	-.075	-.144	-.068	-.092

**p<.01, *p<.05

Table 3

Table 3: Hierarchical regression model with HAPPI mean score as the dependent variable (β coefficients are standardised).

Predictor variables	HAPPI mean		
Step 1 (R^2 =.385)	***B***	***SE B***	***β***
(Constant)	21.13	5.99	
Age	-.46	.29	-.12
ISS Conflict	.01	.02	.08
ISS Depression	.07	.03	.25*
ISS Activation	.02	.01	.12
HPS total	.71	.13	.41**
Step 2 (R^2 =.415)			
(Constant)	23.47	5.92	
Age	-.49	.25	-.13
ISS Conflict	.02	.02	.10
ISS Depression	.07	.03	.25*
ISS Activation	.02	.01	.11
HPS total	.68	.13	.39**
Disabling Conditions Index	-.24	.09	-.18**

**p<.01, *p<.05