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An experimental investigation of the effect of negative mood on the deployment of as-many-as-can checking stop rules and compulsions

Gary I. Britton[a,1] & Graham C. L. Davey[a]

[a] University of Sussex, Brighton, BN1 9RH, UK.

Corresponding author:

Gary I Britton,

University of West London,

Boston Manor Road,

Brentford

Middlesex,

UK,

TW8 9GA.

Email: garyianbritton@gmail.com

[1] Present address: University of West London, Boston Manor Road, Brentford, Middlesex, TW8 9GA, UK. Email: garyianbritton@gmail.com

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Abstract

Objectives: The present study examined the causal effect of negative mood on the deployment of as-many-as-can (AMAC) checking stop rules and compulsions.

Design/Methods: Participants underwent a negative or positive mood induction and subsequently completed self-report measures of AMAC checking stop rules and compulsions.

Results: The negative mood group scored significantly higher on both measures. As hypothesised, the direct causal effect of negative mood on compulsions was fully mediated by AMAC stop rules, with negative mood having a significant indirect effect on compulsions through AMAC stop rules. However, an alternative mediation model also showed that the direct causal effect of negative mood on AMAC stop rules was fully mediated by compulsions, with negative mood having a significant indirect effect on AMAC stop rules through compulsions.

Conclusions: The implications of these findings for the understanding of the relationships between negative mood, AMAC stop rules and clinically relevant perseverative behaviours is discussed.

Keywords: Obsessive-compulsive disorder; Compulsions; Mood-as-input hypothesis; Stop Rules; Negative Mood.

1. Introduction

The mood-as-input (MAI) hypothesis is a theory which attempts to explain the conditions under which an individual will decide to continue with or terminate a task (Meeten & Davey, 2011). According to the MAI hypothesis, decisions about whether to continue with or terminate a task are dependent on the interaction between the individual's "stop rules" for the task, that is what rules have been either implicitly or explicitly deployed to define the goals of the task, and the information available regarding whether those goals have been met. If the available information during a task suggests that the goals for that task have been met, the individual will terminate task-related activity. Conversely, if the information available suggests that the goals for that task have not been met, then the individual is likely to continue with task-related activities. The MAI hypothesis states that an important source of information by which goal-achievement is evaluated is the individual's concurrent mood (Martin, Ward, Achee, & Wyer, 1993; Martin & Davies, 1998). The MAI hypothesis suggests that it is the individual's interpretation of their mood rather than mood per se that has implications regarding the individual's decision to terminate or continue with a task. During the course of performing a task, for example, individual's may ask themselves either explicitly or implicitly "Have I reached my goal?". Generally, an individual in a positive mood will tend to answer yes, whilst an individual in a negative mood will tend to answer no. In other words, individuals in a positive mood are likely to evaluate this positive affect as an indication that they have progressed towards or achieved their goal whilst, in contrast, individuals in a negative mood are likely to evaluate this negative affect as an indication that they have not progressed towards or achieved their goal, and so they are likely to persist with the task (e.g., Martin et al., 1993).

Another important factor in determining the decision of whether to continue with or to terminate a task according to the MAI hypothesis is the "stop rule" the individual has deployed to define the goals of that task (Martin et al., 1993). To date, the mood-as-input literature has primarily focused on two stop rules, the 'as many as can' (AMAC) stop rule and the 'feel like continuing' (FLC) stop rule (Meeten & Davey, 2011). If the individual has deployed an AMAC stop rule, this stop rule will encourage them to continue with the task until they are sure they have met whatever their specific criteria or standard was for that task. In contrast, if an individual has deployed a FLC stop rule, this stop rule will encourage the individual to engage in the task whilst they are enjoying it, without concern about evaluation or without any particular performance standards for the task.

According to the MAI hypothesis, different configurations of mood and stop rule will have different implications in terms of if a task is continued with or terminated. When using a FLC stop rule the individual is more likely to continue with a task if they are in a positive mood as they are likely to interpret this positive mood as a sign that they are enjoying engaging in the task (Martin et al., 1993). Conversely, when using an AMAC stop rule, the individual is more likely to continue with the task if they are in a negative mood, as this negative mood will continually provide information that the goals for that task have not been achieved.

Over approximately the last 20 years the MAI hypothesis has been successfully applied to a number of perseverative behaviours linked to mental health disorders such as worry (e.g., Startup & Davey, 2001) and rumination (e.g., Hawksley & Davey, 2010). The combination of negative mood and AMAC stop rule use is thought to be most relevant to clinically related perseverative behaviours, since heightened negative mood is a common feature of a number of mental health

disorders (e.g., generalised anxiety disorder, mood disorders; American Psychiatric Association, 2013). Another clinically relevant perseverative behavior that the MAI hypothesis has been successfully applied to is checking, which is a symptom observed in more than 80% of clinical presentations of those with obsessive-compulsive (OC) disorder (Ball, Baer, & Otto, 1996; Rasmussen & Tsuang, 1986; Summerfeldt, Antony, Downie, Richter, & Swinson, 1997). Davey, Startup, Zara, MacDonald, and Field (2003, study 1) asked participants to generate a list of things they would check if they were going away on holiday for safety or security reasons. Results indicated that those in a negative mood using an AMAC stop rule generated significantly more items and spent longer on the task than those in a positive mood using the same stop rule. Davey et al. (2003, study 2) attempted to examine another element of perseverative checking, repeated attempts to recollect if a checking activity has been properly carried out. They found that those in a negative mood using an AMAC stop rule spent significantly longer recalling checking items than those in a negative mood using a FLC stop rule. Finally, MacDonald and Davey (2005), using a proof-reading task designed to replicate many aspects of compulsive checking, found that those in a negative mood condition using an AMAC stop rule showed significantly increased perseveration than those using a FLC stop rule across several measures such as the total number of checks, time spent checking and the number of times that individual items were re-checked.

Whilst the studies described above (Davey et al., 2003; MacDonald & Davey, 2005) manipulated both mood and stop rule use, respectively, more recent research has examined the possibility that being in a negative mood may make individuals more likely to deploy AMAC stop rules when engaging in a perseverative behavior or task (Dash & Davey, 2012). If this were found to be the case, it would suggest that

negative mood is the primary cause of engagement in perseverative behaviors, with AMAC stop rule use being triggered by negative affect and subsequently mediating the relationship between negative mood and perseverative behavior. There are several lines of reasoning that suggest that negative mood may have a causal effect on AMAC stop rule deployment. Firstly, negative mood has been shown to have a causal effect on systematic processing (Forgas, 2007) and it is easy to imagine how engaging in systematic processing might encourage an individual to deploy AMAC stop rules when engaging in a task. Secondly, negative mood has been shown to increase performance standards in comparison to positive or neutral mood (Scott & Cervone, 2002), resulting in individuals being relatively dissatisfied with any given level of imagined or real performance (Cervone, Kopp, Schaumann, & Scott, 1994). An increase in performance standards is also likely to facilitate the deployment of AMAC stop rules. Finally, Chan, Davey, and Brewin (2013) found that compared to healthy controls, depressed participants reported a preferential use of the goal-guided stop-rule in response to negative mood states in their daily lives.

Dash and Davey (2012) examined the possibility that negative mood might have a causal effect on AMAC stop rules related to worry. They found that not only did negative mood facilitate the deployment of AMAC worry stop rules, but also that the causal effect of negative mood on worry, as measured by scores on the Penn State Worry Questionnaire, was fully mediated by measures of systematic processing facilitators (specifically, measures of accountability, responsibility, desire for control and need for cognition) together with a measure of AMAC worry stop rules. This finding has led to Davey and Meeten (2016) including a causal pathway between negative mood and AMAC worry stop rules in their recent proximal model of perseverative worry.

The present study aims to clarify and further extend our understanding of the relationship between negative mood, AMAC stop rules and clinically related perseverative behaviours in the following ways. Firstly, whilst Dash and Davey (2012) found a significant effect of negative mood on AMAC stop rule endorsement, they measured stop rules using only a single visual analogue scale (VAS) item. Here, we seek to replicate this finding whilst measuring stop rules using a more comprehensive questionnaire, which shows good internal consistency and correlates in expected directions with other relevant construct measures (Britton, 2011). Secondly, whilst current evidence suggests that negative mood has a causal effect on AMAC worry related stop rules (Dash & Davey, 2012) there is little evidence that negative mood has a causal effect on AMAC stop rules related to other perseverative behaviours. It may be the case that the causal effect of negative mood on AMAC stop rules is specific to AMAC worry related stop rules. The current study will examine if negative mood has a causal effect on stop rules related to checking and therefore if this effect holds for other clinically relevant AMAC stop rules. Finally, Dash and Davey (2012) found that the causal effect of negative mood on worry was fully mediated by measures of systematic processing facilitators together with a measure of AMAC worry stop rules. Whilst current evidence suggests that manipulating negative mood has a causal effect on OC symptoms (e.g., Horowitz, 1985) the potential mediating role of AMAC stop rules in the causal effect of negative mood on OC symptoms has not previously been examined. In the current study we manipulate mood and subsequently measure AMAC checking related stop rules and compulsive symptoms using self-report questionnaires. If the expected causal effect of negative mood on both AMAC stop rules and compulsions is found, AMAC checking stop rules will be examined as a possible mediator of the causal effect of negative mood on

compulsions, as this mediation pattern is indicated by previous research (Dash & Davey, 2012). An alternative mediation model will also be examined if the expected causal effect of negative mood on both AMAC stop rules and compulsions is found, specifically, if the causal effect of negative mood on AMAC stop rules is mediated by compulsions. Whilst this alternative mediation model is not indicated by previous research, it is conceivable from a theoretical perspective that the causal effect of negative mood on AMAC stop rules may be mediated by compulsions. It is also good statistical practice to test alternative mediation models (Kline, 2005).

In the present study, participants were randomly assigned to either a positive or negative mood group and underwent appropriate music-based mood induction procedures. Following these mood inductions, participants were asked to complete measures of mood, checking stop rules and compulsions. Because specific discrete mood manipulations are difficult to achieve in practice (Gross & Levenson, 1995; Rottenberg, Ray, & Gross, 2007; Meeten & Davey, 2012), we adopted a polar, nonspecific valenced mood manipulation using positive or negative mood inductions. Negative mood encompassing both feelings of anxiety and sadness is a common feature of OCD (Frost, Sher, & Geen, 1986; Salkovskis, 1985; Roper & Rachman, 1976).

2. Method

2.1. Participants

Participants were 59 psychology undergraduates (men: 7; women: 52). Aged ranged from 18 to 43 years (M = 21.03, SD = 5.61). All of the participants were volunteers who received partial fulfillment of a course requirement by taking part in the experiment.

2.2. Procedure and Materials

Participants were randomly assigned to one of two groups, depending on the valence of the mood induction they were to receive, these groups were labelled positive (n = 30) and negative (n = 29). Participants were tested individually in a small room containing a PC with headphones and an angle-poise lamp. There was a retractable blind over the only window in the room which could be open or closed (closing of the blind almost completely stopped day light from entering the room). Participants were told the experiment was about music comprehension and memory and how this is related to personality. They were told that they would be asked to listen to some music and then, after a ten minute break, that they would be asked to fill in some questionnaires. This information was presented in a consent form which participants were asked to sign.

Stage 1. Mood Induction: Participants were asked to put the headphones in place so they could listen to a short piece of music. The music lasted approximately 8 minutes. The experimenter left the room whilst the music was playing and returned after 8 minutes. Participants in the negative mood group were asked to listen to a piece of music which has previously been shown to induce a negative mood state (MacDonald & Davey, 2005): Gyorgy Ligeti, *Lux Aeterna*. In addition, the blinds were drawn over the windows and the main room lights were switched off, only the angle-poise lamp was used to illuminate the room. Participants in the positive mood group were asked to listen to a different piece of music: Delibes, *Mazurka* from *Coppelia* (only the section from 1m 46secs to 3m 10secs, looped). The blinds in the room were left open allowing full day light into the room, the main lights were turned on and so was the angle poised lamp.

Stage 2. Ten minute break and short questionnaire: Participants were told in the informed consent form that after listening to the music there would be a ten

minute break before they would be given follow up questionnaires. The experimenter re-entered the room immediately after the music had finished and reminded the participant about the impending ten minute break. The experimenter then asked the participant if they would mind filling in a questionnaire unrelated to the experiment during the ten minute break. Participants were told the questionnaire was related to a separate questionnaire study being conducted by a colleague and that the questionnaire would take just over five minutes to complete. All participants agreed to fill in the questionnaire. The experimenter left the room for ten minutes whilst the participant filled in the questionnaire. The data collected in this questionnaire was actually to be used in the analysis of the present study. The reason for deceiving participants about this questionnaire was to reduce any experimental demand effects and minimise any perceived link between the music as a mood induction procedure and subsequent data collection. The short questionnaire contained a separate consent form. The consent form informed participants the questionnaire study was broadly concerned with decision making. Mood was measured in this questionnaire using three questions where participants were asked to rate their current level of sadness, happiness and anxiety on separate 100 point VASs (where 0 = not at all sad/happy/anxious and 100 = extremely sad/happy/anxious). The questionnaire also contained other items which are not focused on in the present report.

Stage 3. Full questionnaires and debrief. The experimenter re-entered the room after the 10 minute "break" had finished. The experimenter gave the participant another questionnaire booklet and asked the participant to inform the experimenter when they had finished the questionnaire booklet. The experimenter then left the room until the participant had finished the questionnaire booklet. This questionnaire booklet contained a number of questionnaires. The first questionnaire was a "music

comprehension and memory" questionnaire designed specifically for the purposes of this experiment and was not used in the data analysis of this experiment. As part of the questionnaire booklet participants completed the Checking Stop Rule Questionnaire (CSRQ) and the Clark-Beck Obsessive-Compulsive Inventory (CBOCI), which are both outlined below. Once participants had finished filling in the questionnaire booklet, they were debriefed.

2.2.1. The Checking Stop Rule Questionnaire

The CSRQ (Britton, 2011) contains 20 statements, 10 which measure endorsement of AMAC stop rules and 10 which measure endorsement of FLC stop rules. Each statement in the CSRQ refers to checking. An example of a statement reflective of AMAC stop rules is, "I think I've checked everything, but I may not have done it properly, so better keep checking", whilst a statement reflective of FLC stop rules is, "I should stop checking because once is enough, and doing it any more will make no difference". These statements are preceded by instructions asking the participant to imagine they are currently checking something and to indicate to what extent each statement describes the kind of thing the individual is thinking when deciding whether or not to stop checking on 5-point scale (ranging from "not the kind of thing I think of at all" [1] to "I think of this kind of thing a lot" [5]). An initial study by Britton (2011) suggests that two factors underlie the CSRQ, the first measuring AMAC stop rules and the second FLC stop rules and that both of these factors are reliable (reliability for AMAC subscale was $\alpha = .91$, reliability for the FLC subscale was $\alpha = .89$). A second study exploring the validity of the CSRQ found the two subscales correlate in expected directions with other relevant constructs (e.g., the AMAC subscale is significantly positively related to perfectionism and systematic processing, the FLC subscale is significantly negatively correlated with perfectionism

and significantly positively correlated with heuristic processing), providing evidence of the CSRQ's validity (Britton, 2011). Total scores on the AMAC subscale of the CSRQ can range from 10 to 50, with higher scores reflective of more self-reported endorsement of AMAC stop rule related cognitions. Total scores on the FLC subscale of the CSRQ can range from 10 to 50, with higher scores reflective of more self-reported endorsement of FLC stop rule related cognitions. In the present study, the AMAC subscale had excellent internal consistency ($\alpha = .91$) whilst the FLC subscale had very good internal consistency ($\alpha = .89$).

2.2.2. The Clark-Beck Obsessive-Compulsive Inventory

Participants were also asked to complete the CBOCI (Clark, Antony, Beck, Swinson, & Steer, 2005) as part of the questionnaire booklet, a 25-item questionnaire developed to assess the frequency and severity of obsessive and compulsive symptoms. The CBOCI consists of a series of ordered statements relating to particular features of the measure's two subscales, Obsessions (14 items) and Compulsions (11 items). Each item is rated on a four-point scale (0 – 3) according to levels of frequency or severity with higher scores indicative of higher frequency or severity.

In the opening paragraph of the CBOCI, in which the scoring system is explained to participants, in relation to each item, participants are asked to, "…read each group of statements carefully and pick out the one statement in each group that best describes your thoughts, feelings or behaviour during the past two weeks including today". As we were interested in participants responses at the specific time point in which they were measured, rather than over the past two weeks, these instructions were slightly changed for the purposes of the current study and asked participants to instead select, ''…the one statement in each group that best describes your thoughts, feelings, or behaviour at the present moment in time''. Additionally,

for the purposes of the current study, the statement in the original opening paragraph of the CBOCI which reads, “Your first impression of which statement best describes you over the past two weeks will be the most accurate answer” was changed to, “Your first impression of which statement best describes you at the present time will be the most accurate answer”. Otherwise, the general instructions for the CBOCI, including the definitions of obsessions and compulsions, respectively, were unchanged. Small changes were made to the items themselves only when items made reference to specific time periods within the item response (e.g., daily; less than weekly) in which case the reference to these time periods were simply removed. As these specific time period references always appeared within brackets in the original wording of these items, removing them did not alter the overall meaning of the item or the response.

Given the present study is primarily concerned with the link between negative mood, AMAC checking stop rules and checking, only the compulsions subscale of the CBOCI is reported on in this paper. Total scores on the compulsions subscale of the CBOCI can range from 0 to 33, with higher scores indicative of more self-reported engagement in compulsive behaviours and thoughts. The internal consistency of the compulsions sub-scale in the current sample was good ($\alpha = .82$).

3. Results

Group comparisons were made using independent samples t-tests. Two-tailed significance levels are reported.

3.1. Mood Manipulation Check

For the three mood measures, the assumption of homogeneity of variances was violated. Therefore, independent t-tests with Satterthwaite approximation for degrees of freedom were conducted. The negative mood group ($M = 30.65$, SD = 22.23) scored significantly higher on the sadness measure than the positive mood

group (M = 09.57, SD = 08.07), t(35.03) = 4.81, p < .001, d = 1.080. The positive mood group (M = 73.90, SD = 10.33) scored significantly higher on the happiness measure than the negative mood group (M = 56.79, SD = 19.46), t(42.36) = 4.20, p < .001, d = 1.144. The negative mood group (M = 37.53, SD = 26.48) scored significantly higher on the anxiety measure than the positive mood group (M = 18.20, SD = 17.28), t(47.96) = 3.32, p = .002, d = 0.834. These data suggest that participants in the negative mood group were significantly more anxious and sad, and less happy than participants in the positive mood group.

3.2. Stop Rule Measures

The negative mood group (M = 2.89, SD = .93) scored significantly higher on the AMAC subscale of the CSRQ than the positive mood group (M = 2.37, SD = .96), t(57) = 2.10, p = .04, d = 0.556. Conversely, the positive mood group (M = 3.04, SD = .98) scored significantly higher on the FLC subscale of the CSRQ than the negative mood group (M = 2.58, SD = .73), t(57) = 2.08, p = .04, d = 0.551.

3.3. Compulsions

The negative mood group (M = .72, SD = .46) scored significantly higher on the compulsions subscale of the CBOCI than the positive mood group (M = .45 SD = .39), t(57) = 2.45, p = .02, d = 0.649.

3.4. Predicted mediation model

As outlined in the introduction, Dash and Davey (2012) found that measures of systematic processing facilitators together with a measure of AMAC worry stop rules fully mediated the relationship between negative mood and worry. Given the negative mood group scored significantly higher than the positive mood group in terms of AMAC checking stop rules in the current study, as well as on the compulsions measure, a mediation analysis was conducted to examine if the causal

effect of negative mood on compulsions was partially or fully mediated by AMAC checking stop rules. Analyses were performed using the statistical package Analysis Of Moment Structures (AMOs) 22. Given that neither compulsions or AMAC checking stop rules were targeted directly by the mood manipulation used in the present study, it is of note that these two variables were significantly positively correlated with each other, $r(59) = .58$, $p < .001$.

In both of the mediation analyses described below, the *x* variable is the categorical grouping variable used to separate the two mood groups in the current study, that is the negative and positive mood groups. The *m* and *y* variables used in each analysis are the mean score on the relevant full questionnaire subscale measure, for the respective *m* and *y* variables in each analysis. Bootstrapping (1000 samples) was used to evaluate the significance of the indirect pathways. Standardised beta-values are reported. Full mediation is said to have occurred in the current paper if the previously significant pathway between variables *x* and *y* (pathway *c*) is no longer significant when the *m* variable is added into the model as a mediator of the relationship between *x* and *y* (pathway *c'*) (Baron & Kenny, 1986).

Before the effect of the mediator was taken into account, the mood grouping variable significantly predicted compulsions ($\beta = .31$, $p = .02$, pathway *c*). This is reflective of the significant difference between the negative and positive mood groups in terms of compulsions as reported in section 3.3, and of a direct causal effect of negative mood on compulsion scores.

When the AMAC subscale total score of the CSRQ was added into the model as a mediator of the relationship between the grouping variable and compulsions, the direct relationship between the grouping variable and compulsions was no longer significant ($\beta = .17$, $p = .13$, pathway *c'*). The indirect pathway connecting the

grouping variable to compulsions through AMAC subscale total score was significant ($z = 0.14$, $p = 0.03$). The relationship between the grouping variable and compulsions is therefore is fully mediated by AMAC stop rules, suggesting that whilst negative mood has a significant causal effect on compulsions, this effect is fully mediated by AMAC stop rules, and negative mood therefore does not have a significant direct causal effect on compulsions when the mediating effect of AMAC stop rules is taken into account. This mediation analysis is depicted graphically in figure 1.

INSERT FIGURE 1 HERE.

Figure 1. Mediation analysis with the mood grouping variable (labelled negative mood to aid in interpretation) as variable *x,* compulsions as variable *y*, and AMAC stop rules as variable *m*. Standardised beta values and their significance (*$p = .04$, **$p < .001$) are reported. Note that significant indirect effects are not shown.

3.5. Alternative mediation model

An alternative mediation model is also theoretically conceivable which differs from the model described in the previous section, where compulsions potentially mediate the causal effect of negative mood on AMAC checking stop rules. In order to examine this possibility a mediation analysis was conducted to see if the causal effect of negative mood on AMAC checking stop rules was partially or fully mediated by compulsions.

Before the effect of the mediator was taken into account, the mood grouping variable significantly predicted AMAC checking stop rules ($\beta = .27$, $p = .04$, pathway *c*). This is reflective of the significant difference between the negative and positive

mood groups in terms of AMAC checking stop rules as reported in section 3.2, and of a direct causal effect of negative mood on AMAC checking stop rule scores.

When the compulsions subscale of the CBOCI was added into the model as a mediator of the relationship between the grouping variable and AMAC stop rules, the direct relationship between the grouping variable and AMAC stop rules was no longer significant (β = .16, p = .19, pathway c'). The indirect pathway connecting the grouping variable to AMAC stop rules through compulsions was significant (z = 0.11, p = 0.01). The relationship between the grouping variable and AMAC stop rules is therefore is fully mediated by compulsions, suggesting that whilst negative mood has a significant causal effect on AMAC stop rules, this effect is fully mediated by compulsions, and negative mood therefore does not have a significant direct causal effect on AMAC stop rules when the mediating effect of compulsions is taken into account. This mediation analysis is depicted graphically in figure 2.

INSERT FIGURE 2 HERE.

Figure 2. Mediation analysis with the mood grouping variable (labelled negative mood to aid in interpretation) as variable x, AMAC stop rules as variable y, and compulsions as variable m. Standardised beta values and their significance (*p = .02, **p = .005) are reported. Note that significant indirect effects are not shown.

4. Discussion

In the experiment described in this paper, mood was manipulated and the effect of doing so on both AMAC checking stop rule deployment and compulsions was measured. Negative mood appears to have a causal effect on self-report questionnaire measures of AMAC checking stop rule deployment and compulsions. A

mediation analysis suggests that the causal effect of negative mood on compulsions is fully mediated by AMAC checking stop rule deployment, as hypothesized, with negative mood having a significant indirect effect on compulsions through its causal effect on AMAC stop rules. However, testing of an alternative mediation model also suggests that the causal effect of negative mood on AMAC checking stop rule deployment is fully mediated by compulsions, with negative mood having a significant indirect effect on AMAC stop rules through its causal effect on compulsions.

The finding that negative mood has a causal effect on AMAC checking stop rules is in line with the results of Dash and Davey (2012) who found a causal effect of negative mood on AMAC worry stop rules. In the current study AMAC checking stop rules were measured using a comprehensive questionnaire, which shows good reliability and has evidence to support its validity. Given that Dash and Davey (2012) measured AMAC worry stop rules using only a single VAS item, the results of the current study can be seen as providing more robust support for the causal effect of negative mood on AMAC stop rules. Moreover, the current study extends the findings of Dash and Davey (2012) by showing that negative mood has a causal effect on AMAC checking stop rules, suggesting that this effect is not limited to AMAC worry related stop rules. Future research may wish to explore if negative mood has a causal effect on stop rules related to other clinically relevant perseverative behaviours, such as rumination.

Whilst the present study focused on the causal effect of negative mood on AMAC checking stop rules, it has been proposed that AMAC stop rule deployment is likely to also be triggered by clinical constructs such as inflated responsibility (Meeten & Davey, 2011). In the case of inflated responsibility, it is believed that

many individuals who score highly on this construct are driven to perform compulsive behaviors in order to avert potentially disastrous negative consequences for themselves or their loved ones (Salkovskis, 1985). Such a motivation is likely to lead to the deployment of AMAC stop rules (Meeten & Davey, 2011). Further, constructs such as inflated responsibility have been shown to have bidirectional causal relationships with negative mood (Britton & Davey, 2014) and therefore manipulation of these constructs might influence AMAC stop rule deployment through their relationship with negative mood. Future research may wish to explore if clinical constructs such as inflated responsibility have a causal effect on AMAC stop rule deployment.

Whilst the causal effect of negative mood on OC symptoms is consistent with past research (e.g., Horowitz, 1985) the finding that AMAC checking stop rules fully mediate the causal effect of negative mood on compulsions is an addition to the existing literature and is in line with Dash and Daveys' (2012) finding that systematic processing measures and AMAC worry stop rules fully mediate the causal effect of negative mood on worry. However, this is not the only model consistent with the data obtained in the current study. Compulsions also fully mediated the relationship between negative mood and AMAC checking stop rules, as shown in the alternative mediation model analysis. This alternative model would suggest that engaging in compulsions may lead to the deployment of the AMAC checking stop rules. At present, however, whilst evidence exists suggesting a causal effect of AMAC stop rule use on compulsions as is specified in the hypothesised mediation model (e.g., MacDonald & Davey, 2005), there is no evidence indicative of a causal effect of compulsions on AMAC stop rule deployment, as is specified in the alternative mediation model. Indeed, evidence suggests that as perseveration at a task persists,

individuals turn to deploying FLC rather than AMAC stop rules (Davey, Eldridge, Drost, & MacDonald, 2007), supporting the first mediation model over the second. Future research may wish to examine if compulsions have a direct causal effect on AMAC stop rule use through experimental manipulation and therefore if the alternative mediation model is a viable one.

In respect to the two mediation models examined in the current paper, it is worth noting that the direct *c* pathways between negative mood and compulsions (.31, predicted mediation model), and negative mood and AMAC stop rules (.27, alternative mediation model), were only small to moderate in size before the effect of the relevant mediator was taken into account, as was the total effect of negative mood on the *y* variable when the relevant mediator was added into each mediation model. This is reflective of the fact that both compulsions and AMAC stop rules are likely to also be causally influenced by variables other than negative mood, variables that were not measured or directly manipulated in the current study (e.g., inflated responsibility). It is also worth noting that the reduction in size of the standardised beta-values between variable *x* and variable *y*, when variable *m* was taken into account, was similar in both the predicted mediation model (.14), and the alternative mediation model (.11), and in both cases the reduction in size was relatively small. The authors would speculate that this similar reduction in standardised beta-value size seen in the two *c'* pathways, maybe due to shared variance between the respective predictor variables in the two models. Indeed, negative mood has been shown to moderately positively correlate with both AMAC stop rules (Britton & Davey, 2017) and OC symptoms (Moore & Howell, 2017).

From a treatment perspective, Dash, Meeten, Jones, and Davey (2015) showed that a psychoeducation program based around the basic principles of the MAI

hypothesis (i.e., providing guidance on how to identify and change worry-relevant goal-directed decision rules and negative moods) was successful in reducing worry scores in a non-clinical sample compared to befriending. Whilst interventions based on MAI principles for OC symptoms do not currently exist to the authors' knowledge, the findings of this study would suggest that as well as informing patients about the effects of negative mood and checking stop roles on compulsions, such an intervention should also highlight that being in a negative mood may implicitly or explicitly encourage an individual to deploy AMAC checking stop rules.

The current study does have some limitations, partly dictated by the requirements of the experimental design and the need to avoid demand effects. Firstly, measures of mood were taken only post-manipulation and not pre-manipulation to ensure that participants were not alerted to the significance of mood and the purpose of the experiment prior to the manipulation. The study therefore does not have the capacity to show an increase or decrease in scores on the relevant mood measures post-manipulation compared to baseline levels. However, a random sampling procedure was used that permits the assumption of equality across experimental groups and allows post-manipulation inference of effects of the experimental manipulation on subsequent post-manipulation measures (Campbell, 1957). Secondly, a non-clinical sample was used in the current study, and this may have led to floor effects in terms of participant responses to the measures used in the current study, especially the CBOCI. However, it should be noted that taxometric studies have suggested that OC symptoms are generally best considered as dimensional rather than categorical (e.g., Haslam, Williams, Kyrios, McKay, & Taylor, 2005) and many cognitive models of OC symptoms follow a dimensional model (e.g., Frost & Steketee, 2002) supporting the appropriateness of studying OC

related phenomena in analogue samples. Moreover, much research into the MAI hypothesis and clinically related perseverative behaviours have utilised non-clinical samples (e.g., Dash & Davey, 2012; Dash et al., 2015). Nonetheless, the validity of the results presented in this paper would be strengthened if they were replicated within a clinical sample. Thirdly, compulsions were measured using a self-report measure. Whilst this is in line with similar studies such as Dash and Davey (2012), who measured worry using the Penn State Worry Questionnaire, the results of the current study would be strengthened if they were replicated using a behavioural measure of compulsions. Fourthly, in their recent review of mood induction procedures, Siedlecka and Denson (2019) recommend using visual over auditory stimuli to induce negative mood states such as sadness, and positive mood states such as happiness. Whilst music was used in the current study to induce mood states, rather than visual stimuli, the mood manipulation checks employed in the current study suggest that the mood induction procedure used was successful in manipulating sadness, anxiety and happiness in the intended directions between the two mood groups. Finally, the power produced by the sample size used in the current study maybe considered relatively low for testing mediation models (see e.g., Fritz & MacKinnon, 2007).

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6. Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments or

comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

7. Informed consent

Informed consent was obtained from all individual participants included in the study.

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