Can Imagining Actions as Occurring Involuntarily Cause Intentional Behaviour to Feel Involuntary?

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Abstract

The cold control theory of response to imaginative suggestions calling for distortions in veridical experience (including hypnotic suggestions) states that behavioural and cognitive responses are generated intentionally, but are perceived as involuntary due to inaccurate higher order thoughts of intending. Previous research has placed imagination as central to this response, yet imagined scenarios alone do not appear to result in feelings of automaticity or involuntariness. Here we seek to explore whether imagined involuntariness, while imagining not being aware of thoughts to the contrary, will result in a greater sensation of involuntariness. We compared training in imagined involuntariness with simple practice in responding to imaginative suggestions, by comparing scores for subjective response and feelings of involuntariness for six suggestions. The pilot results have been confirmed as reproducible by an independent statistician. The results were insensitive, but a (not pre-registered) post hoc analysis indicated that had the test suggestions been limited to motor suggestions (as the training had been), with the hallucination suggestions eliminated, then it would have found evidence to support the training group resulting in greater subjective effects and sensations of involuntariness than the control group. In this registered report we replicate the procedure but with a test phase of only motor suggestions, to attempt to confirm the finding that the training on motor suggestions works for motor suggestions. If that study is successful, we will repeat but with the training including hallucination suggestions and a test phase of only hallucination suggestions to determine whether training can generalise to hallucination suggestions as well as motor suggestions. The results bare on the debate as to whether hypnotic response can be trained.

Keywords: hypnosis, hypnotic suggestions, imaginative suggestions, higher order thoughts, metacognition, involuntariness, automaticity, phenomenological control

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People have the capacity to intentionally create subjective experiences that systematically misrepresent reality, and yet seem real; that is, people have the capacity for phenomenological control (Dienes & Lush, 2023). For example, people can be asked to make their hands feel like magnets attracting their hands together, and many people by imagining this state of affairs in the right way can then feel their hands move together as if by themselves. The ability to create such experiences is related to the efficacy of certain clinical treatments that use this ability, such as hypnotic analgesia (Flammer & Gombartz, 2003), and is sometimes desired for its potential to increase enjoyment of other enriching experiences generally (e.g. erotic pleasure, de Rivière, 2023). A natural question, and the one that we will address, is whether the capacity for phenomenological control is, like a skill, something that can be trained and thus enhanced. Hypnosis is one context where people apply their ability for phenomenological control, and most relevant previous research on training phenomenological control has been conducted in that context. Thus, we will consider hypnosis first, before moving on to our study testing the training of phenomenological control outside that context.

Hypnosis has historically been described as a process that starts with a hypnotic induction, after which the participant (or "subject") enters a hypothesised "hypnotic state" or "trance", in which they become responsive to hypnotic suggestions (which feel automatic and involuntary), until the process is terminated (Pinter & Lynn, 2009). Early research onwards (for example, Barber et al, 1974; Hull, 1933; Martin & Dienes, 2019) indicated that the putative hypnotic state was unnecessary for participants to respond to the same suggestions as they would otherwise respond to while in the state; The induction made little difference to the response. The response to hypnotic suggestions therefore appears to not require hypnosis at all, and instead requires only the application of the capacity for phenomenological control (Dienes et al., 2022). That is, participants can simply be asked to make their experiences feel automatic or involuntary and, if sufficiently motivated, they will do so to the best of their abilities. This capacity is roughly normally distributed, whether outside or inside

the hypnotic context (i.e. whether or not a hypnotic induction is used and the suggestions are called hypnotic; Lush et al., 2021).

Suggestions presented with no induction and no mention of hypnosis are not "hypnotic" as no hypnotic ritual is involved; instead, following Braffman and Kirsch (1999), we refer to them as "imaginative suggestions" to distinguish from other forms of suggestion that are unrelated to these investigations (e.g. self-affirmation; Sherman & Cohen, 2006). Our research, presented here, pertains to whether response to imaginative suggestions can be enhanced through cognitive training in the use of imagination, and specifically whether certain imaginings can make otherwise ordinary behaviour feel more involuntary than it otherwise would.

Theories of Phenomenological Control

The questions of whether and in what way phenomenological control can be trained should be usefully informed by a good explanation of how phenomenological control works. It is the hypnosis literature that has provided the richest set of theories of the mechanism of phenomenological control. Responses to imaginative suggestions depend on participants causing the dissociation, or causing the feelings of involuntariness or automaticity, in response to imaginative suggestions. What is it that the successful participant is doing? We will first consider socio-cognitive theories, which rely on everyday cognitive processes for responding to social situations (Spanos, 1986), before turning to dissociation theories.

Sarbin and Coe (1972) proposed that responsive participants simply enact the role of a hypnotised person in the same way that an actor might become immersed in enacting a role for a play. They argued that just as an actor may temporarily forget that they are simply acting, and instead fully become the part they are playing, a hypnotised person may also become so immersed in their role that they are unaware that they are simply enacting it. Barber et al. (1974) thought that the notion of role was incidental, but that just as Sarbin and Coe placed great emphasis on acting "as if" the suggestions were true, what was needed was "thinking and imagining with the themes of the suggestions" (page 59) by engaging in "goal-directed imagining" which would allow behaviour to feel

automatic. Differences in attitudes, motivations and expectancies of the participants explained both why some suggestions were responded to and others were not; and why everyday imagining (of the same things) did not generate behaviour that felt automatic. They did not, however, describe how cognitive processes are specifically changed by attitudes, motivations or expectancies, nor what participants who were successfully responding did differently compared to those that did not respond. In short, they did not explain how attitudes, motivations and expectancies changed the effect of imagining specific things so that in one context they caused behaviour that felt automatic, while in another they did not.

Kirsch (1985) and Kirsch and Lynn (1999) expanded on these theories by isolating the underlying mechanism of hypnotic response as being due to solely the expectancies of the participant (response expectancy theory). Response expectancy theory claims participants respond well to the extent they have the expectancy that the action would feel automatic. The later response set theory put a twist on this claim by stating that all thoughts and actions are actually automatic, and are chosen solely based on which fit most appropriately for any given situation. The theory suggests that everything is already automatic, and that responses to imaginative suggestions reveal this automaticity. However, there is a distinction between automatically following habit and performing executive function tasks (e.g., Jacoby, 1991), and labelling everything as automatic fails to recognize a real psychological distinction.

Wagstaff (1981) claimed that participants simply distracted themselves from the fact that they instigated the suggested behaviour. This does not appear to stand up to much scrutiny, however. While it may be possible to distract oneself from a pain stimulus or from retrieval cues to prevent recall of information, for example, distraction is terminated as soon as awareness is drawn back to the active strategy. In contrast, participants responding to suggestions for analgesia or amnesia maintain that the effect was/is automatic and involuntary, even under extended questioning (Barber et al., 1974). If response to imaginative suggestions could be explained by distraction then we would assume that the felt involuntary nature of the responses would not

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persist once attention was drawn to their performance. Maintaining the illusion of non-volition

when all attentive resources are directed towards attempts to investigate the phenomena would

imply that something other than distraction was required to explain it.

Dissociation theories attempt to address these problems. Woody and Sadler (2008)

suggested three forms that dissociation could take to support the automatic or involuntary nature of

response to imaginative suggestions. Dissociated control theory suggests that imaginative

suggestions are acted upon by sub-systems of control that are dissociated from the executive

control functions. In essence, the executive control function, which would normally be involved in all

intentional behaviour, is not involved in responding to suggestions and, instead, other sub-systems

with control of the relevant behaviour are responsible. In this case there is no prior intention by the

participant to perform the specific act suggested; it is triggered by the suggestion rather than

deliberately enacted. You could say there is an "intention in action" (the act is meaningful and goal-

directed) but not a prior intention (Searle, 1980).

The theory of dissociated experience, conversely, suggests a disjoint between intentional

behaviour (effectively directed by the executive control function) and its effective monitoring by the

executive monitoring function. This disjoint supports the notion that suggested behaviour is

intentional but is perceived as non-intentional. Second-order dissociated control represents a

dissociation between the executive control and executive monitoring functions. This theory also

suggests that responses to imaginative suggestions are intentional, but that while they are correctly

monitored by the executive monitoring function this information fails to reach the executive control

function.

Cold control theory (Dienes & Perner, 2007) describes the (dissociation or sociocognitive)

self-deception accounts in terms of inaccurate higher order thoughts of intention, which result in

intentional behaviour (produced by the executive system) feeling unintentional, and therefore

feeling automatic or involuntary. The theory is based on a hierarchy of orders of mental states

(Rosenthal, 2002), with in this case intentions being the relevant first order state (i.e. a state about

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the world) and the awareness of the intention being the higher order state. The theory suggests that intentional behaviour could occur (specifically, behaviour caused by an executive intention, the first order state), without awareness of that intention (i.e. without an accurate higher order state). The result would be behaviour that is experienced as happening without awareness of intention, and hence behaviour that would feel as if it were unintentional.

Enhancing Phenomenological Control

Some attempts to enhance phenomenological control involve short term changes due to non-invasive disruption of brain operation by rTMS (Dienes & Hutton, 2012; see Coltheart et al., 2018; Faerman et al., 2024; Kekecs & Souza, 2024); restricted environmental stimulation (Darakjy et al., 2015); or use of psychoactive substances such as LSD (Carhart-Harris et al., 2015), nitrous oxide (Whalley & Brooks 2009), or alcohol (Semmens-Wheeler et al., 2013).

Methods for training phenomenological control with the goal of long lasting benefits have been inspired by socio-cognitive theories. Gorassini and Spanos (1999) developed a 75-minute cognitive training programme (Carleton Skills Training Programme [CSTP]) that consisted of three goals: "secure cooperation", "induce enactment", and "induce self-deception". Securing cooperation involved correcting misconceptions that a participant might have about hypnosis (explaining that they'll be in control, that they won't be in a trance, that it will feel quite normal, etc), as failing to engage with hypnosis out of fear was seen as a significant reason for low responsiveness to suggestions. Enactment, in this context, involved the participants adopting "the perspective of a character responding hypnotically to suggestions" and was seen as the most important of the three components because "there can be no experience of hypnotic responsiveness if there are no responses." Further they stated that low responsiveness to suggestion was often the result of participants waiting for responses to occur automatically, instead of actively engaging in causing them to occur. For the self-deception goal, participants were instructed to "deem stories told in suggestions as descriptions of actual events" but without further explanation of how to actually do

so. The CSTP has been studied extensively with results indicating that 50% of low responders subsequently present as high responders following the training (for review, see Gorassini, 2004).

Bates et al. (1988) replicated the effects of the CSTP (albeit with 27% of participants with initially low response to suggestion [lower 10%] presenting with high responses [upper 10%] rather than the >50% reported by most replications) but found at 4-month follow-up that none were still responding in the high category but that almost half had response scores in the medium category. Additionally, they found that a group who were told that the retest and follow-up were unrelated to the training had significantly lower scores than those in the replication group, although still greater than their pre-test scores. Bates (1992) also replicated the CSTP results, but instructed a group of participants with initially low responses to suggestion to "be honest" in their reporting. As a result, this group scored lower gains than those of the replication group. While Bates et al. and Bates interpreted their results as indicating that insincere compliance to demand characteristics played a substantial role in the CSTP gains, other conclusions could be drawn. For example, the "honesty" instructions could have constituted demand characteristics that implied any gains were due to participants lying, and that therefore participants should actually lie about any increases they experienced! Equally, in the Bates et al. experiment, perhaps the lack of rapport (as identified by Lynn, 2004) had a negative impact on the immediate and follow-up results (also see Gfeller et al., 1987).

To address these concerns, Spanos et al. (1996) instructed a group of participants to fake engagement with the CSTP while another group were trained as usual; during retest, half of each group were left alone but surreptitiously observed (while believing they were not). Spanos et al. found that the simulators stopped responding when they believed they were not being observed, but that natural high responders and those trained to become high responders both responded as expected, even when they believed they were alone. These results would suggest that demand characteristics do not play a significant role in the reported responses of those trained to become high responders. Even considering the role that demand characteristics might play, the results from

Bates et al. and Bates indicate that a significant proportion of participants still benefit from the training when the effects of the suspected demand characteristics are controlled.

Wickless and Kirsch approached the task of increasing phenomenological control through the lens of modifying expectancies. Instead of cognitive training, they opted to deceive participants into thinking they were responding automatically to suggestions when in fact they may not have been responding at all. They did this by giving challenging suggestions while also surreptitiously modifying the environment to give the effect that the participants were responding to the suggestions. In one experiment, they gave suggestions that participants would experience a change in their vision amounting to everything appearing redder than it usually is. In tandem, they very subtly illuminated a hidden red light, which had the effect of making the room appear increasingly redder than it originally was. As a result of the interventions, participants responded to (different) suggestions greater than the control group, with 73% scoring as high responders, 27% as moderate, and none as low. Kirsch et al. replicated the effect and demonstrated that knowledge of the deception was negatively correlated with response to suggestion, indicating that the improvements were not due to demand characteristics arising from conscious awareness of the deception attempts. Benham et al. (1998), however, found that while the surreptitious manipulations increased expectancies about subsequent responsiveness, they did not in fact increase actual response.

Based on the theory that response to suggestion depends on the correct deployment of attention, Parra and Rey reworded a suggestion for arm immobilisation into instructions to imagine a) that the arm was immobile and b) that there was nothing the participant could do about it – a part of a method independently proposed by Anthony Jacquin and Kevin Sheldrake (Sheldrake, 2012) and that we test here. They reported that the responses to these instructions were significantly greater than the responses to the original suggestion on which they were based. Instead of a typical between-groups or within-subjects design, the response scores were compared against typical responses to suggestions in the Stanford Hypnotic Susceptibility Scale, Form C ([SHSS:C],

Weitzenhoffer & Hilgard, 1962). They construe the increase in responding as based on alternating attention between interoceptive sensations and imagining the scenario suggested. The training instructions, however, consisted of advice to imagine in a certain way. Now we consider why appropriate use of imagination may increase response.

None of these interventions explicitly attempted to isolate targeting awareness of intention, to see if addressing the specific mechanism postulated by cold control theory is possible through training. But how could one intervene on higher order thoughts of intending? Comey and Kirsch (1999) reported that, with regards to response to imaginative suggestions, the use of imagination was a modal strategy that appeared to be employed by the majority of successful responders. Ordinary, everyday imagination, however, does not typically result in the feeling that intentional behaviour is unintentional, so just imagining along with a suggestion appears inadequate to explain the feelings of automaticity or involuntariness. A participant imagining a helium balloon tied to their wrist in a non-hypnotic context does not typically find their arm rising automatically; whereas the same imagining in a hypnotic context may facilitate such behaviour. In short, there is something unique that occurs in the hypnotic context, in tandem with the imagining of the suggested scenario. Cold control theory suggests that the role of imagination in response to imaginative suggestions might therefore be related to the manipulation of the higher order thoughts. In order to train the skill of phenomenological control, it may be useful to practice imagining not having higher order thoughts of intending.

In our pilot study, participants were assigned to one of two groups, control and intervention. In both groups participants were not hypnotised, and no mention of the word hypnosis was used, as per the Phenomenological Control Scale (PCS) (Lush et al, 2021). The experiment was presented as exercises in the use of imagination. In place of the PCS introduction, task motivation statements were given instead as it was felt that the imagination exercise in the PCS introduction (walking down stairs while becoming absorbed in imagination) could suggest or prompt thoughts of hypnosis, as such an exercise has often been portrayed in fiction as being part of a hypnotic induction. Our task

motivation statements simply asked the participants to engage their imagination, to do their best to succeed with the exercises, and to not worry about how good they think their imagination is.

Both groups were then exposed to an initial set of suggestions in the practice phase. The control group was simply motivated to actively imagine. The intervention group was asked to intentionally produce the required behaviour (e.g. arm rising in the air) but to imagine it was involuntary. If when asked they said some thought or cue stopped them from imagining it was involuntary, they were asked to imagine that thought or cue was not there. Finally, both groups were tested on a further different set of suggestions. In the PCS, participants self-score their own subjective experience based on how strongly they felt the effects of each suggestion. Given our intervention, we also asked participants to score how involuntary each suggestion felt. Cold control theory suggests that increased feelings of involuntariness about a cognitive behaviour, such as pretence or imagination, makes pretence feel like belief and imagination like perception. As such, the theory predicts that the intervention will increase both the subjective experience and the sensations of how involuntary it is. Had we only measured an increase in the subjective experience, it would have been difficult to argue that participants were in fact experiencing the effects as involuntary happenings, as opposed to simply playing along.

Based on the theory that imagining not having higher order thoughts of intending facilitates not having higher order thoughts of intending, it was predicted that the intervention group would have a greater feeling of involuntariness than the control group in the test phase. Given the theory that experienced involuntariness is the basis of the experience feeling real, the intervention should increase subjective ratings of the reality of the situation suggested.

Pilot Experiment

Methods

Participants

The availability of psychology students at University of Sussex willing to take part in experiments diminishes dramatically after the end of the academic term. We therefore pre-

registered (https://osf.io/k58h4) that we would run a maximum of 136 participants, but would stop at the end of the academic term even if that number had not been reached. Participants were 43 female, seven male, one non-binary, and one unspecified (did not declare their gender) undergraduate students drawn from the psychology department at University of Sussex. Participants were recruited using the psychology department's Sona Systems platform, and were rewarded with credits towards their studies. All participants were assumed to have taken the phenomenological control scale previously during a group session, but this was not required or confirmed. Participants were randomly assigned to the control group (24 female, three male) or the intervention group (21 female, four male, one non-binary, and one who did not declare their gender). A simple computer algorithm based on the Unix rand() function (seeded with the time the program started to cause each run to be different) generated random pairs of allocations, each either {control, intervention} or {intervention, control}. The program was configured to generate at least 60 pairs of allocations.

The Unix rand() function is pseudo-random; each allocation pair was decided based on the least significant bit of its output. By generating pairs of allocations, the algorithm guarantees the same number of allocations for each group, leading to a 50:50 ratio of allocations.

Participants were provided with information about the experiment in the advert and were informed that by signing up they were consenting to taking part. This research was approved (ER/DIENES/14) by the Sciences & Technology Cross-Schools Research Ethics Committee (C-REC) (crecscitec@sussex.ac.uk). The University of Sussex has insurance in place to cover its legal liabilities in respect of this study.

Measures

The questionnaires were designed on the Qualtrics XM platform and were identical for the two groups. For each suggestion, the questionnaire presented the participant with two horizontal sliders that accepted integer responses in the range of 0 to 5. The first slider asked the participant how strongly they felt the effect; the second asked how involuntary the effect felt. For the subjective score, 0 indicated that they did not experience the effect and 5 indicated that they experienced the

effect as if it was entirely real. For the involuntariness score, 0 indicated that the experience was perceived as entirely voluntary and 5 indicated that the experience was perceived as entirely involuntary.

The surveys were anonymous, with each participant being labelled with a unique random identifier which was not linked to any of their personal details. The participants were not provided with this identifier. The participants in the control group all provided their inputs on a questionnaire that was internally coded as "control"; and those in the active group provided their inputs on a questionnaire that was internally coded as "active". The participants were not informed which group they were in.

Procedure

Sessions were divided into practice and test, with practice conducted over individual Zoom sessions, and test being self-administered through an audio recording embedded in a questionnaire.

Practice phase. Both groups received the same introduction that consisted of task motivation statements that informed participants that they had an active role in the study, that they should engage their imagination, and that they should try their best to succeed (Appendix A). The control group was then presented with three imaginative suggestions: hand lowering, hands moving together, and hands stuck together (Appendix B). The first two of these were taken verbatim from the PCS; the third was adapted from the PCS suggestion for arm immobilisation.

The intervention group was provided with interactive training to achieve the same three suggestions (Appendix C). For each suggestion, the participants were instructed to intentionally enact the required behaviour, and to imagine that the behaviour was happening automatically. Up to five attempts were made for each suggestion, with the experimenter encouraging the participants to identify imagined scenarios that would help make their behaviour feel more involuntary, and then to include those imaginary scenarios in their subsequent attempts. The experimenter also encouraged the participants, on each attempt, to imagine not being aware of thoughts or feelings that would remind them of their volition.

Test phase. The tests immediately followed the practice and were identical for each group (Appendix D). The participants were given a link to an online questionnaire and were instructed to exit the Zoom session in order to complete it. The questionnaire first asked the participants to score how strongly they felt the effect of each of the practice suggestions, and how involuntary they felt them to be, both on Likert scales from 0 to 5. It then presented them with a 10-minute (approx.) audio that delivered six more suggestions, and finally asked them to score each of those suggestions in the same manner.

The six suggestions were: mosquito hallucination, arm immobilisation, taste hallucination, arm rigidity, music hallucination, and hand rising. The first five suggestions were taken verbatim from the PCS; the sixth was adapted from the PCS suggestion for hand lowering. Participants then re-joined the Zoom session to confirm that they had completed the questionnaire, and for the experimenter to thank them and complete the session.

Results

All analyses and tables have been certified as computationally reproducible by an independent statistician (reproducibility report here: https://osf.io/v3bme). The pilot study was pre-registered on the Open Science Framework website at https://osf.io/k58h4 using the template from AsPredicted.org.

Pre-registered Results

The raw data and R scripts are available at https://osf.io/cf7kh. The individual scores for both the subjective and involuntariness ratings were averaged (mean) for each participant for practice and test. These individual scores represented the participants' experiences of deploying phenomenological control. The subjective scores indicate how much each felt the effects of the suggestions and the involuntariness scores indicate how involuntary the effects felt. These scores were then averaged (mean) per session and per group (Table 1).

Table 1

Pilot Group Means and Standard Deviations

Sub-session	Group Name	Subjective		Involuntariness		n
		M	SD	M	SD	
Practice	Control	3.23	0.70	2.80	0.93	27
Practice	Intervention	3.49	0.74	3.54	0.82	27
Test	Control	2.74	0.75	2.47	0.73	27
Test	Intervention	2.93	0.62	2.77	0.72	27

Bayes factors and t-tests were calculated for each sub-session for both subjective and involuntariness scores (Table 2). For the Bayes factors we used a *t-distribution* for the likelihood with a *mean* equal to the difference between the means of the two groups, an *SD* equal to the *SE* of the difference, *df* = the *df*. We modelled H_1 with a half-normal prior with *mean* = 0 and *SD* = 0.5 Likert units of subjective/involuntariness scale. These models matched the pre-registration. We use the definitions of evidence from Lee & Wagenmakers (2014).

Table 2

Pilot Bayes Factors and t-tests

Sub-session	Measure	Mean Difference	SE	$B_{HN(0, 0.5}$ Likert units)	RR	t-test	df	p
Practice	Subjective	0.26	0.20	1.40	[0, 2.55]	1.33	51.85	.190
Practice	Involuntariness	0.74	0.24	31.02**	[0.21, > 5]	3.09	51.17	.003
Test	Subjective	0.19	0.19	0.89	[0, 1.43]	0.99	50.19	.327
Test	Involuntariness	0.30	0.20	1.87	[0, 3.47]	1.53	52.00	.131

** Strong evidence for H_1

The Bayes factor for the involuntariness measure for the practice indicated strong evidence for H_1. Note the predictions referred to the test phase. Comparisons for the test phase were insensitive ($1/3 < B < 3$).

Non-Pre-registered Results

A post-hoc investigation, not pre-registered, questioned whether the training had been applied equally to all of the suggestions in the test set. In particular, it was noted that the

training had included only motor suggestions (hand lowering, hands coming together, hands stuck together), whereas the test suggestions included both motor suggestions and hallucination suggestions. The training may have been successful for the motor suggestions but had not generalised to the hallucination suggestions. A re-analysis was conducted with the hallucination suggestions (mosquito hallucination, taste hallucination, music hallucination) removed from the test set (Table 3).

Table 3

Pilot Group Means and Standard Deviations, Ignoring Hallucination Suggestions

Sub-session	Group Name	Subjective		Involuntariness		n
		M	SD	M	SD	
Test	Control	3.32	0.83	2.84	0.94	27
Test	Intervention	3.73	0.67	3.58	0.88	27

Bayes factors and t-tests were calculated as before (Table 4). The Bayes factor for the subjective measure indicated moderate evidence for H_1. For the involuntariness measure, the Bayes factor indicated strong evidence for H_1. That is, there was non-pre-registered evidence that the training worked.

Table 4

Pilot Bayes Factors and t-tests, Ignoring Hallucination Suggestions

Sub-session	Measure	Mean Difference	SE	$B_{HN(0, 0.5 \text{ Likert units})}$	RR	t-test	df	p
Test	Subjective	0.41	0.21	3.81*	[0.21, 0.72]	1.98	49.89	.053
Test	Involuntariness	0.74	0.25	24.63**	[0.21, > 5]	2.99	51.78	.004

* Moderate evidence for H_1 ** Strong evidence for H_1

Discussion

The experiment, as pre-registered, was insensitive regarding evidence for the training intervention. The strong evidence for the feeling of involuntariness for the active training session

versus the control practice session indicates that the training had an effect on how the practice suggestions felt to the participants.

The post-hoc (not pre-registered) analysis, which focused only on the motor suggestions in the test set, suggests that the training failed to generalise to hallucination suggestions and instead only worked well for the motor suggestions. It would appear that participants mostly failed to grasp how to construct a successful strategy for responding to hallucination suggestions. It would appear that the instruction to "make the scenarios happen" only made sense to the participants in respect to motor suggestions where overt behaviour was required. When participants had to hallucinate a mosquito, a taste or a sound, they failed to generate the suggested scenario and, as a result, failed to make it feel involuntary. This could be because creating a mosquito, taste or sound does not necessarily translate well from the training instructions to make the required behaviour. Perhaps imagining was not recognised as a behaviour in the typical sense.

While this subsequent analysis was not pre-registered and was post-hoc, it would appear that the results may support the hypothesis that training to intentionally enact suggested motor behaviour and to imagine that it is happening involuntarily, may increase phenomenological control. In conclusion, training might have been successful on one class of suggestions (motor) but not on another (hallucinations); further investigation with minimal changes is needed to confirm this hypothesis.

Pre-registered Experiments

In these experiments we plan to replicate the pilot study with a few specific changes. In the first experiment, we will replicate the pilot but with only motor suggestions in both practice and test phases. If this produces evidence for the training, then a second replication will be conducted but with hallucination suggestions included in the practice phase, and with only hallucination suggestions in the test phase. These two experiments will allow us to test if the training works for motor suggestions (as suggested by the pilot) and, if so, if it can also generalise to hallucination suggestions if specific training is given for them.

In addition, in both experiments, the instruction to "make the scenarios happen" will be expanded with specific reference to hallucinations; the aim here is to keep the training as similar as possible across the two experiments, aside from the actual suggestions presented. In order to balance the number of times each suggestion is practiced in the practice/training phase, the control group will be given the opportunity to repeat each suggestion the same number of times as the training group. Finally, in order to address questions of experimenter confound, the vast majority of the experiment will be fully automated with the practice/training sessions also pre-recorded.

Based on the theory that imagining not having higher order thoughts of intending facilitates not having higher order thoughts of intending, it is predicted that those instructed to imagine that their behaviour happens automatically, and that they are unaware of higher order thoughts, will exhibit greater phenomenological control than those that do not, resulting in the intervention groups achieving higher phenomenological control scores than the control groups.

Methods

Participants

We will recruit undergraduate psychology students at the University of Sussex via the psychology department's Sona Systems platform. All BSc psychology students are registered on the platform where they can see advertised experiments and can earn credits towards their studies in exchange for participation. We will restrict recruitment to students who have previously been screened for Phenomenological Control Scale (PCS) score, where their PCS score is not in the top 10% in order to exclude highly responsive participants to avoid potential ceiling effects (with thanks to the reviewer who suggested this). Students who took part in the pilot experiment will not be eligible for participation in these experiments and the system will prevent them from signing up to it. Equally, students who participate in the first pre-registered experiment will not be eligible for participation in the second experiment. Due to the automated nature of the experiments, which include exercises presented via pre-recorded audio, the experiments will not be open to deaf

students. As the second experiment involves imaginative suggestions for negative visual hallucinations, this experiment will not be open to blind students.

Participants will be provided with information about the experiments in the adverts and will be informed that by signing up they are consenting to taking part. As before, sessions will be conducted over Zoom with participants completing an anonymous questionnaire related to their experiences. This research has been approved (ER/DIENES/14) by the Sciences & Technology Cross-Schools Research Ethics Committee (C-REC) (crecscitec@sussex.ac.uk). The University of Sussex has insurance in place to cover its legal liabilities in respect of this study.

We will rely solely on Bayes factors to draw statistical inference; this permits us to use optional stopping (Rouder, 2014). We will recruit at least 50 participants for each experiment. We estimated the needed number of subjects by a Monte Carlo simulation to determine probability of achieving a Bayes factor threshold if a) there were a difference between groups; and b) if there were not. For each simulated study, the Bayes factor was calculated with the same model of H_1 as in the Pilot, which we also use here. Specifically, H_1 was modelled as a half-normal distribution with the mean equal to 0 and the SD equal to 0.5 Likert units; and H_0 was modelled as a point, namely population mean difference as equal to 0 Likert units. When assuming H_1, that there was a group difference, the likelihood was a *Student-t*, with the expected *mean* equal to a mean difference of 0.5 Likert units (in the Pilot, the mean difference between groups was 0.41 for subjective realness, and 0.74 for involuntariness, which averages to 0.58 Likert units, close to the value we roughly predicted before the pilot was run, namely 0.5 Likert units). When assuming H_0, that there was no difference, the mean of the likelihood was set to 0. We used the SE of the mean difference obtained in the pilot, taking into account its uncertainty, to inform simulated SEs. Specifically for each simulated study, we sampled from a scaled inverse-chi distribution centred on the variance calculated from the square of the SE of the mean differences (0.21 for subjective realness, and 0.25 for involuntariness), and the df equal to $(n_1 - 1) + (n_2 - 1)$. The sampled variance was then adjusted by the ratio of the given N, and N of the Pilot. Square rooting the variance yielded the SE of the mean difference for a simulated

study. By varying the number of participants N (with $n_1 = n_2 = N/2$), we ran 1000 simulations per value of N and calculated the proportion of simulations that achieved a specified Bayes factor threshold (see Appendix M for details). We found that $N=73$ (for each experiment) would result in Bayes factor $B > 5$ with 80% probability for both subjective realness and involuntariness measures, assuming the same mean differences as in the pilot experiment. The same calculations except with the likelihood *mean* equal to 0 revealed that requiring a Bayes factor $B < 1/5$ with 80% probability would need 387 participants for each experiment. This was deemed infeasible given the number of undergraduate psychology students available and the number of experiments competing for their participation. Instead, the same approach revealed that a Bayes factor $B < 1/3$ could be achieved with 80% probability with 130 participants for each experiment. We will run the critical analyses on the data for each participant once at least 50 have participated, and will cease recruiting participants either once $B > 5$, or else $B < 1/3$, or else we reach 130 no matter how strong the evidence is. While the stopping rule is with respect to $B > 5$, all decisions will be made with respect to either $B > 3$ (for evidence for H_1) or $B < 1/3$ (for evidence for H_0). By having a larger B for stopping than making decisions, our decisions will have some robustness to change in scale factor (for claims of H_1, but not of H_0, which will not be so robust).

Measures

The online questionnaires were designed on the Qualtrics XM platform. Both procedures are entirely automated. At the start of the questionnaires, the system will randomly allocate each participant to either the control or intervention group and will not reveal this to the participant. The nature of the upcoming practice will be briefly described to participants. The values of the subjective realness and involuntariness scales will be explained. Prior to the practice suggestions, the questionnaire will ask the participant to score how different they think their average scores will change as a result of the practice/training exercises that they will receive. These will be requested on sliders that accept integer values between -5 and 5 Likert units. The first slider will ask for how they think their average subjective experience of the strength of the effects will change; the second

will ask for how they think their average feelings of involuntariness will change. These are the expectation ratings.

For each suggestion, the questionnaire will present the participant with two horizontal sliders that accept integer responses in the range of 0 to 5 Likert units. The first slider will ask the participant how strongly they felt the effect; the second will ask how involuntary the effect felt. For the subjective score, 0 indicated that they did not experience the effect and 5 indicated that they experienced the effect as if it was entirely real. For the involuntariness score, 0 indicated that the experience was perceived as entirely voluntary and 5 indicated that the experience was perceived as entirely involuntary.

The surveys will be anonymous, with each participant being labelled with a unique random identifier which will not be linked to any of their personal details. The participants will not be provided with this identifier.

Procedure

Participants will be provided with a link to a Zoom meeting for the arranged session. At the start of the meeting, the experimenter will greet the participant, explain the nature of the experiment and describe what will happen (Appendix E). The experimenter will then provide the participant with a link to the questionnaire that contains the embedded audio recordings and will prompt for the measures. The participant will then exit the Zoom session, complete the questionnaire, and then return to the Zoom session. The experimenter will then answer any questions the participant has. The purpose of the two zoom calls, one at the beginning and one at the end of the session, is to ensure the participant is alone in a quiet space and anticipates being without interruptions for 30 minutes, and does complete the study in one sitting, without either taking extended breaks or else rushing.

The questionnaire will randomly assign each participant to either the control group or the intervention group. They will be informed that they need to use headphones and be seated in an environment where they will be unlikely to be disturbed. The survey will play an audio recording of

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the script provided in Appendix F. For participants in the control group, the survey will then play the audio recording for the control group practice (Appendix G for experiment 1 and Appendix J for experiment 2), pausing and asking the participant to provide their expectancy ratings and their involuntariness scores for each suggestion. The survey will automatically repeat each suggestion up to five times or until the participant scores the involuntariness as 5. Participants in the intervention group will be played the audio recording of intervention training (Appendix H for experiment 1 and Appendix K for experiment 2), pausing for input and repeating exercises in a similar fashion. Both groups will then be asked to provide their subjective and involuntariness scores for the practice/training exercises. Next, they will be played an audio recording of the test suggestions (Appendix I for experiment 1 and Appendix L for experiment 2), after which the survey will ask the participant to score the test suggestions in the same way.

For the first experiment, the practice/training suggestions will be: head nod, hands moving together and hands stuck together (Appendices G and H). The test suggestions will be: hand lowering, arm immobilisation, hand rising, and arm rigidity (Appendix I). For the second experiment, the practice/training suggestions will be: hands moving together, hands stuck together, music hallucination and a negative hallucination for a black circle (Appendices J and K). The test suggestions will be: mosquito hallucination, taste hallucination, a negative sound hallucination, and a colour draining hallucination (Appendix L). The majority of the suggestions were taken verbatim from the PCS. The suggestion for hands stuck together was adapted from the PCS suggestion for arm immobilisation. The hand rising suggestion was adapted from the PCS suggestion for hand lowering. The negative hallucination for a black circle, the negative sound hallucination, and the colour draining hallucination were developed using the style of the PCS suggestions.

Analysis

Bayes factors for the differences of the subjective realness and involuntariness means of each group will be calculated for the practice sessions and the test sessions, taking the relevant expectancy rating as a covariate in each case. We will use a *t-distribution* for the likelihood with a

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Deleted: A simple computer algorithm based on the Unix rand() function (seeded with the time the program started to cause each run to be different) will generate random pairs of allocations, each either {control, intervention} or {intervention, control}. The program will be configured to generate at least 60 pairs of allocations.¶
The Unix rand() function is pseudo-random; each allocation pair will be decided based on the least significant bit of its output, which is believed to be unbiased. This guarantees a perfect 50:50 ratio of each order of allocation over an infinite number of runs; a shorter sequence will be biased towards one allocation order over the other, although the direction of the bias is undetermined. By generating pairs of allocations, the algorithm guarantees the same number of allocations for each group, leading to a 50:50 ratio of allocations.

Deleted: Each session will be initiated with a Zoom video call, the link for which being made available to participants via the Sona Systems platform ahead of the session. The experimenter will then follow the script for either the control group or the intervention group, depending on allocation. Both scripts start with the same introduction (Appendix E). The control group will then be given three practice imaginative suggestions (Appendix F); the intervention group will be given training in responding to the same three suggestions, based on the hypothesis that instructions to use imagination in a particular way will increase capacity for phenomenological control (Appendix G).¶

Deleted: After the practice or training is complete, the experimenter will provide the participant a web link to an online questionnaire. The links for the two groups will be different and will be embedded in the script. The questionnaires will however be identical, other than their internal naming that is not available to the participants. They will be designed and presented using the Qualtrics XM online software. Participants will be instructed to leave the Zoom call, complete the questionnaire, and return to the Zoom call. The Zoom call will not be recorded.¶
The questionnaire will ask the participants to score their experiences for each of the three practice/training suggestions, for both how strongly they felt the effects, and for how involuntary each of the effects felt. It will then play an embedded video clip containing audio of the experimenter providing six more suggestions. The video element of the clip will consist of a single frame throughout, instructing the participants to keep their eyes closed until instructed to open them.¶
At the end of the clip the participant will be instructed to open their eyes. The questionnaire will then ask them to score their experiences for the six suggestions, on the same axes as before. It will then instruct them to re-join the Zoom call. On re-joining, the experimenter will read the final part of the script (Appendix H), informing them that the experiment is over, thanking them for their involvement and answering any questions they may have.¶
The three practice/training suggestions will be: hands moving together, hands stuck together, and music hallucination (Appendices F and G). The first and third of these has been taken verbatim from the PCS (Lush et a[... [8]

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mean equal to the difference between the means of the two groups, an *SD* equal to the *SE* of the difference, *df* = the *df*. We will model H_1 with a half-normal prior with *mean* = 0 and *SD* = 0.5 Likert units of subjective/involuntariness scale (Dienes, 2019). The half-normal *SD* was kept the same as the pilot study. In fact, in the pilot, the average difference between the intervention and control group for just the test motor suggestions (where we found evidence for a difference) was 0.58 Likert units, close to 0.5 Likert units.

A non-essential outcome neutral test will be whether expectancy for intervention effectiveness was equalized in the two groups. As the scale for measuring expectancy of effectiveness was in terms of change in the crucial outcome variables in original units, we can test equivalence with a Bayes factor using as model of H_1 the same model as for the outcome variables themselves, that is, a half-normal with an *SD* of 0.5 Likert units. A Bayes factor will be calculated for each of expectancy for change in subjective realness and involuntariness. It does not matter if the outcome is evidence for H_0, insensitive, or evidence for H_1: either way we will use expectancy as a covariate in the main analyses, as detailed above. Thus, this outcome neutral test is non-essential. This variable is used to account for differences in demand characteristics between the two groups.

In the pilot, all participants who attended completed all measures. However, if in the main study a participant does not finish a study in any way, that is does not complete all measures, the data for that participant will be excluded, and a new participant run to replace them if needed to reach *N* = 130, or else the Bayes factor thresholds.

The two measures (subjective realness and involuntariness) permit testing of two hypotheses, namely that imagining suggested behaviour as happening involuntarily will facilitate the behaviour being experienced as more "real", and more involuntary. Cold control theory predicts that suggested behaviour that feels more involuntary will also feel more "real" (and vice versa), and also that suggested behaviour that feels more "real" will also feel more involuntary (and vice versa). If one measure finds evidence for H_1 but the other measure finds evidence for H_0, then this would challenge cold control theory as it currently stands.

Evidence for H_1 for both measures would suggest that the capacity for phenomenological control can be increased through training in imagining suggested behaviour as occurring involuntarily. Evidence for H_0 for both measures would suggest that the training made no difference to the capacity for phenomenological control. As the hypotheses are independent, the evidence for each can be reviewed separately, especially if one or both are insensitive.

Study Design Template

Question	Hypothesis	Sampling plan	Analysis Plan	Rationale for deciding the sensitivity of the test for confirming or disconfirming the hypothesis	Interpretation given different outcomes	Theory that could be shown wrong by the outcomes
Does imagining that suggested motor behaviour is happening involuntarily cause the behaviour to feel more involuntarily?	Those instructed to imagine that their motor behaviour happens automatically, and that they are unaware of higher order thoughts to the contrary, will experience their behaviour as more involuntary than those that do not.	50 undergraduate psychology students from University of Sussex, who have previously scored in the lower 90% of PCS scores, will be initially recruited. We will continue to recruit from same pool until both test Bayes factors are sensitive ($B < 1/3$ or $B > 5$) or we reach 130 participants. The rough minimum (50) and maximum (130) were calculated to show they provide opportunity for achieving threshold levels of evidence.	Bayes factors for the differences of the means of each group will be calculated for the test sessions. We will use a t-distribution for the likelihood with a *mean* equal to the difference between the means of the two groups, an *SD* equal to the *SE* of the difference, df = the df. We will model H_1 with a half-normal prior with *mean* = 0 and *SD* = 0.5 Likert units of subjective/ involuntariness scales (Dienes, 2019). Expectancy will be added as a covariate (expectancy for change in subjective realness for the subjective realness test, and expectancy for change in involuntariness for the involuntariness test). Thus, the mean difference referred to above will be the adjusted	$B > 3$ is the amount of evidence just worth taking note of, by tradition. We estimated that 130 participants provide an 80% probability of getting evidence for H_0 should it be true; and an even higher probability for getting evidence for H_1 should it be true.	$B > 3$: imagining that suggested motor behaviour happens involuntarily facilitates behaviour feeling more involuntary. $B < 1/3$: imagining that suggested motor behaviour happens involuntarily does not facilitate behaviour feeling more involuntary. $1/3 < B < 3$: evidence is insensitive.	Imagining not having higher order thoughts of intending facilitates not having higher order thoughts of intending, resulting in suggested motor behaviour being experienced as more involuntary than those that do not.
Does imagining that suggested motor behaviour is happening involuntarily cause the behaviour to feel more "real"?	Those instructed to imagine that their motor behaviour happens automatically, and that they are unaware of higher order thoughts to the contrary, will experience their behaviour as more "real" than those that do not.				$B > 3$: imagining that suggested motor behaviour happens involuntarily facilitates behaviour feeling more "real". $B < 1/3$: imagining that suggested motor behaviour happens involuntarily does not facilitate behaviour feeling more "real". $1/3 < B < 3$:	Imagining not having higher order thoughts of intending facilitates not having higher order thoughts of intending, resulting in suggested motor behaviour being experienced as more "real" than those that do not.

			mean difference, and the SE of the difference referred to above will be the adjusted SE of the difference.		evidence is insensitive.	
Are the groups equivalent in terms of expectancy for treatment effectiveness for motor suggestions?	The two groups are equivalent in terms of expected change in subjective realness and also involuntariness.	Same as above, as theoretical decisions do not depend on the outcome, and the N estimated above probably applies here as well (but we do not have an independent estimate of the SE of the difference for this measure).	Two Bayes factors: DV for one will be expectancy for change in subjective realness, and DV for the other will be expectancy for change in involuntariness. Model of H_1 will be a half-normal with a mode of 0 and an $SD = 0.5$ Likert units. A point H_0 of zero will be used.	As above.	If $B > 3$ for either, then for that measure expectancies were not equivalent; if $B < 1/3$ for either, then for that measure expectancies were equivalent.	The motivational instructional and protocol for each group produced the same expectancies for change, so any difference between the groups on the main measures cannot be attributed to mere compliance to demand characteristics.

Deleted: Given the involuntariness measure comes out $B > 3$, then for subjective experience:¶
$B > 3$:¶
suggested behaviour perceived as involuntary is perceived as "real".¶
$B < 1/3$:¶
suggested behaviour perceived as involuntary is not necessarily perceived as "real" (the claim in the final column, of cold control theory, is false).¶
$1/3 < B < 3$:¶
evidence is insensitive.¶
¶
If $B < 1/3$ for involuntariness then for subjective experience:¶
$B > 3$: Subjective reality can be constructed without creating involuntariness for the constructive act (so the crucial link between them postulated by cold control theory is false);¶
$B < 1/3$: with no involuntariness for constructing the experience, subjective reality cannot be constructed, corroborating cold control theory.

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Does imagining that suggested hallucinations are happening involuntarily cause the hallucinations to feel more involuntary?	Those instructed to imagine that their imaginings happen automatically, and that they are unaware of higher order thoughts to the contrary, will experience their hallucinations as more involuntary than those that do not.	50 undergraduate psychology students from University of Sussex, who have previously scored in the lower 90% of PCS scores, will be initially recruited. We will continue to recruit from same pool until both test Bayes factors are sensitive ($B < 1/3$ or $B > 5$) or we reach 130 participants. The rough minimum (50) and maximum (130) were calculated to show they provide opportunity for achieving threshold levels of evidence.	Bayes factors for the differences of the means of each group will be calculated for the test sessions. We will use a t-distribution for the likelihood with a *mean* equal to the difference between the means of the two groups, an *SD* equal to the *SE* of the difference, $df =$ the *df*. We will model H_1 with a half-normal prior with *mean* = 0 and *SD* = 0.5 Likert units of subjective/ involuntariness scales (Dienes, 2019). Expectancy will be added as a covariate (expectancy for change in subjective realness for the subjective realness test, and expectancy for change in involuntariness for the involuntariness test). Thus, the mean difference referred to above will be the adjusted mean difference, and the *SE* of the difference referred to above will be the adjusted *SE* of the difference.	$B > 3$ is the amount of evidence just worth taking note of, by tradition. We estimated that 130 participants provide an 80% probability of getting evidence for H_0 should it be true; and an even higher probability for getting evidence for H_1 should it be true.	$B > 3$: imagining that suggested motor behaviour happens involuntarily facilitates behaviour feeling more involuntary. $B < 1/3$: imagining that suggested motor behaviour happens involuntarily does not facilitate behaviour feeling more involuntary. $1/3 < B < 3$: evidence is insensitive.	Imagining not having higher order thoughts of intending facilitates not having higher order thoughts of intending, resulting in suggested motor behaviour being experienced as more involuntary than those that do not.
Does imagining that imagining that suggested hallucinations are happening involuntarily cause the hallucinations to feel more "real"?	Those instructed to imagine that their imaginings happen automatically, and that they are unaware of higher order thoughts to the contrary, will experience their hallucinations as more "real" than those that do not.				$B > 3$: imagining that suggested motor behaviour happens involuntarily facilitates behaviour feeling more "real". $B < 1/3$: imagining that suggested motor behaviour happens involuntarily does not facilitate behaviour feeling more "real". $1/3 < B < 3$: evidence is insensitive.	Imagining not having higher order thoughts of intending facilitates not having higher order thoughts of intending, resulting in suggested motor behaviour being experienced as more "real" than those that do not.

Are the groups equivalent in terms of expectancy for treatment effectiveness for suggested hallucinations?	The two groups are equivalent in terms of expected change in subjective realness and also involuntariness.	Same as above, as theoretical decisions do not depend on the outcome, and the N estimated above probably applies here as well (but we do not have an independent estimate of the SE of the difference for this measure).	Two Bayes factors: DV for one will be expectancy for change in subjective realness, and DV for the other will be expectancy for change in involuntariness. Model of H_1 will be a half-normal with a mode of 0 and an $SD = .5$ Likert units. A point H_0 of zero will be used.	As above.	If $B > 3$ for either, then for that measure expectancies were not equivalent; if $B < 1/3$ for either, then for that measure expectancies were equivalent.	The motivational instructional and protocol for each group produced the same expectancies for change, so any difference between the groups on the main measures cannot be attributed to mere compliance to demand characteristics.

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Appendix A – PILOT Introduction Script

Hello, I'm X. Thank you for volunteering to take part in this study. You are free to stop at any point and no one will be offended if you change your mind or decide that you don't wish to continue. That said, there is nothing that we'll do today that should make you feel uncomfortable. Most people find it an enjoyable experience.

There are two parts to this study. First, we'll do some exercises and then I'll give you a survey link. We'll then end this Zoom session, so you can progress through the survey. It will ask you to score the exercises, and then will give you some more exercises to do, via a recording of me talking; then you can score those exercises, and finally re-join the Zoom session so that we can wrap up and finish. It should take less than half an hour in total.

Before we start, I will give you some information about what we're going to do. Please feel free to stop me and ask questions about anything that you don't understand. Please don't feel like you have to wait for a pause to say something; just interrupt me to let me know. Is that okay with you? Great, then I'll read you the information.

- Today we're going to do some imagination exercises to see how your powers of imagination can affect your experiences.

- When I ask you to imagine things, please do your best to imagine them as well as you can. Imagine those things are actually happening to you; see what you would see, hear what you would hear, and feel what you would feel, as if those things were completely true and real. I'd like you to fully act the part as if those things were real, making whatever movements are necessary for that to be the case, for the duration of each exercise.

- I'd like you to immerse yourself fully in these imaginings. Please do not be concerned with how good you think your imagination is. You may surprise yourself with what is possible just through your imagination, regardless of how well you think you can imagine.

- I'd like you to understand that you have a very active role in this process. I want you to enjoy these experiences and, most importantly, I want you to engage fully with them, with the aim of them being successful. Most people who really engage with the process have an interesting and fun experience.

- When people are asked to imagine things, some of them do so briefly; they see the image or whatever, and then they stop imagining. Others continue to imagine the thing until they are asked to stop imagining it. Today, I'd like you to continue to imagine the things I ask you to until I ask you to stop.

- Most people find it easier to imagine these things with their eyes closed, so I'll ask you to do that during the exercises.

- As well as imagining things that aren't real, we can also imagine that we're not aware of certain thoughts or feelings; and as a result, while we're imagining that, we can feel as if those thoughts or feelings are not happening.

- All of the effects of this process will not persist beyond the end of our session. I can assure you that you will end the session as exactly the same person you were when we started it, although you may have a memory of an enjoyable experience.

Appendix B – PILOT Control Group Practice Suggestions

<u>Read out the whole script except for the headings and the parts that are underlined – these are instructions to the experimenter.</u>

Hand Lowering

Please close your eyes.

Now hold your right hand out at shoulder height, with the palm of your hand facing up. Your right hand straight out in front of you, the palm up. There, that's right.... Attend carefully to this hand, how it feels, what's going on in it. Notice whether or not it's a little numb, or tingling; the slight effort it takes to keep from bending your wrist; any breeze blowing on it. Pay close attention to your hand now. Imagine that you are holding something heavy in your hand... maybe a heavy bowling ball - something heavy. Shape your fingers around as though you were holding this heavy object that you imagine is in your hand. That's it.... Now the hand and arm feel heavy, as if the weight were pressing down...and as it feels heavier and heavier the hand and arm begin to move down... as if forced down... moving... moving... down... down... more and more down... heavier... heavier... the arm is getting more and more tired and strained... down... slowly but surely... down, down... more and more down, the weight is so great, the hand is so heavy... You feel the weight more and more... the arm is too heavy to hold back... it goes down, down... more and more down...

<u>Allow 5 seconds.</u>

That's good... now let your hand go back to its original resting position. You probably experienced much more heaviness and tiredness in your arm than you would have if you had not concentrated on it and had not imagined something trying to force it down. Your hand and arm are now as they were, not feeling tired or strained....

Moving Hands Together

Now extend your arms ahead of you, with palms facing each other, hands about a foot apart. Hold your hands about a foot apart, palms facing each other. I want you to think about a

force acting on your hands to pull them together, as though one hand were attracting the other.

You are thinking of your hands being pulled together, and they begin to move together... coming

together... coming together... moving together... closer together... more and more towards each

other... more and more...

Allow 5 seconds.

That's fine. You notice how closely thought and movement are related. Now place your

hands back in their resting position.

Hands Stuck Together

Now extend your arms ahead of you, as before, but with the palms pressed together. I want

you now to think about your hands. Pay close attention to them. They are beginning to stick

together … Notice that sensation as your hands begin to stick … Your hands are beginning to stick

together … Tighter and tighter … More and more stuck. You might like to find out a little later how

sticky your hands are … they seem too stuck to separate them … but in spite of how stuck they are,

maybe you can move them a little; but maybe they are too stuck for that … Why don't you see how

stuck they are … Just try to separate your hands, just try.

Allow 5 seconds.

That's fine. Now place your hands back in their resting positions. Your hands and arms now

feel normal again. They are no longer sticky or stuck.

Please open your eyes.

Interlude

Ask the participant to open the survey link, disconnect from the Zoom session, score these

first three exercises, complete the next set of exercises, score them, and then re-join the Zoom

session:

https://universityofsussex.eu.qualtrics.com/jfe/form/SV_25nRXd9360K6RQG

I've placed a URL in the Zoom chat. Please open that, enter the password "imagine" in lower-case, and click the arrow. Then progress through the survey and re-join the Zoom session when you've completed it.

In the survey there is a recording of me giving you a few more scenarios to imagine. When I give you these descriptions, I'd like you to apply the same strategies and approaches to imagination as you have just done. I'd like you to imagine these things in response to these descriptions, just as you did with the previous scenarios, by working out the things that you need to imagine to make the scenarios happen in such a way that they feel involuntary. Do you have any questions about that?

Appendix C – PILOT Intervention Group Training Suggestions

Training Information for Experimenter – Do Not Read to Participant

The aim of the Automatic Imagination Model process is to cause the participant to enact behaviour that feels automatic or involuntary. The training process for a suggestion involves two steps; the first step asks the participant to make the behaviour that is the goal of the suggestion – e.g. that an outstretched arm will move down.

The second step asks the participant to make the required behaviour again and also to imagine that they are unaware that they are involved in the process, as if the behaviour has happened all by itself. This step is typically more difficult than the first step and is expected to fail on early attempts.

Each time this step fails, because they report that the behaviour does not feel automatic or involuntary, it can be assumed that this is because the participant was reminded that they are responsible for the behaviour. These "reminders of reality" are Higher Order Thoughts (HOTs) that can also be imagined not to occur, or not to be noticed nor acted upon, if the participant is so instructed.

It is expected that a few iterations of these steps will be required, with each failure resulting in the experimenter asking what reminded the participant that they were aware that they were causing the behaviour, and then an additional instruction to imagine that the reminder (HOT) will not be present, or will not be noticed, when they attempt the second step again. Each subsequent iteration includes all the previous imaginings plus the new instruction related to the most recent adverse HOT. In other words, the participant is asked to imagine that all of their adverse HOTs will be missing or ignored.

If a participant succeeds in imagining that these adverse HOTs will not present or will be ignored, then they are likely to report that the behaviour feels automatic and involuntary as, as far as they are concerned, they are successfully imagining that they are not the cause of the behaviour, and therefore have no agency over it.

In the following, read the parts in bold out loud to the participant. Do NOT read out the parts that are not in bold; these are instructions to the experimenter. It is more important that, during the training session, the participant grasps the idea of what they are being asked to imagine, rather than the specific words that are said to them. This is a fluid process aimed at teaching the participant to imagine the two steps as set out above.

One note about the format of the instructions to the participant. The script uses the form "Can you imagine …" rather than "Please imagine …". The reason for this form is that, when phrased as a question, the participant has more freedom to express that they cannot imagine the scenario, whereas in the direct instruction form, the participant may have a tendency to silently fail if they do not think what is being instructed is possible for them. This failure is likely accompanied with adverse HOTs that further compound the failure ("I'm not very good at this", "I can't imagine these things", "The experiment will fail", etc).

The benefit of asking "Can you imagine …" is that if a participant says they cannot, the experimenter has options to ask them to imagine it in a different way, or to imagine something slightly different that would possibly be more likely to result in success. For example, during the hands stuck together suggestion, if the participant simply cannot imagine their hands being inseparable, the experimenter could ask if they've ever had their hands stuck together, or know anyone who has, or could imagine that someone could get their hands stuck, with, for example, super glue.

While this has the disadvantage of suggesting a GDF, the benefit of giving the participant a plausible scenario to imagine when they failed to conjure one up themselves, could outweigh this disadvantage; and it could lead to successful imagining where otherwise there would be none.

Read out the whole script except for the headings and the parts that are underlined – these are instructions to the experimenter.

Training Suggestion 1 – Hand Lowering

Step 1

What I'd like you to do is to place your right arm straight out in front of you – you can turn to the side if that's more convenient and comfortable – and in a moment, when I indicate, I would like you to move your arm down so that it takes about 2 seconds to go all the way down like this.

Mimic moving arm down.

Okay, please close your eyes and move your arm down so it takes about 2 seconds to go all the way down.

Wait for arm to go down.

Great, thanks you can open your eyes. I imagine that you knew you were making that movement voluntarily?

Step 2

Now, the idea is that we're going to try to make that feel involuntary through the use of imagination. So, I'd like you to do it again, when I indicate, but this time I'd like you to also imagine that you're not involved in the process at all, as if your arm is moving down all by itself. Can you imagine that while you do this? Okay, please do that now.

Wait for arm to go down.

What we're aiming for is for that to feel completely involuntary, as if it was happening all by itself and that you aren't involved in the process. Did that feel like it was happening to you?

If they report that it felt volitional, or if they do not have something they could imagine that would make it feel involuntary: How did you know you were moving your arm? Was it something you thought, something you felt, or something else? Feed back the participant's answer as something else to imagine: Can you imagine all that again, and this time also imagine that this reminder won't happen, or that you won't notice it, just for the time it takes to complete this exercise?

Repeat this last sub-step up to four additional times or until the participant reports that it felt involuntary.

Okay, this is just your imagination and you can stop imagining that anytime you like, can't you? Please stop imagining that now and open your eyes.

Training Suggestion 2 – Moving Hands Together

Step 1

Now, please extend your arms ahead of you, with palms facing each other, hands about a foot apart – again you can turn to the side if that's more convenient and comfortable. In a moment, when I indicate, please close your eyes and move your hands together so that they take about 2 seconds to touch.

Mimic moving hands together.

Okay, please close your eyes and move your hands together so that they take about 2 seconds to touch.

Wait for hands to touch.

Great, thanks you can open your eyes. I imagine that you knew you were making that movement voluntarily?

Step 2

Now, the idea is that we're going to try to make that feel involuntary through the use of imagination. So, I'd like you to do it again, when I indicate, but this time I'd like you to also imagine that you're not involved in the process at all, as if your hands are moving all by themselves. Can you imagine that while you do this? Okay, please do that now.

Wait for hands to touch.

What we're aiming for is for that to feel completely involuntary, as if it was happening all by itself and that you aren't involved in the process. Did that feel like it was happening to you?

If they report that it felt volitional, or if they do not have something they could imagine that would make it feel involuntary: How did you know you were moving your hands? Was it something

you thought, something you felt, or something else? <u>Feed back the participant's answer as</u>

<u>something else to imagine:</u> Can you imagine all that again, and this time also imagine that this

reminder won't happen, or that you won't notice it, just for the time it takes to complete this

exercise?

<u>Repeat this last sub-step up to four additional times or until the participant reports that it</u>

<u>felt involuntary.</u>

Okay, this is just your imagination and you can stop imagining that anytime you like, can't

you? Please stop imagining that now and open your eyes.

Training Suggestion 3 – Hands Stuck Together

Step 1

Now extend your arms ahead of you, as before, but with the palms pressed together – again

you can turn to the side if that's more convenient and comfortable. In a moment, when I indicate,

please close your eyes and keep your hands together but do everything you can to try to pull them

apart. What I mean, is don't let your hands separate, but enact all the muscles and strength you can

to try to separate them, right up to the point where they would separate. Does that make sense?

<u>Mimic hands stuck together.</u>

Okay, please close your eyes and keep your hands together while doing your best to

separate them.

<u>Wait for 5 seconds.</u>

Great, thanks you can open your eyes. I imagine that you knew you were doing that

voluntarily?

Step 2

Now, the idea is that we're going to try to make that feel involuntary through the use of

imagination. So, I'd like you to do it again, when I indicate, but this time I'd like you to also imagine

that you're not involved in the process at all, as if your hands cannot be separated all by themselves.

Can you imagine that while you do this? Okay, please do that now.

<u>Wait for 5 seconds.</u>

What we're aiming for is for that to feel completely involuntary, as if it was happening all by itself and that you aren't involved in the process. Did that feel like it was happening to you?

<u>If they report that it felt volitional, or if they do not have something they could imagine that would make it feel involuntary:</u> How did you know you were stopping your hands moving? Was it something you thought, something you felt, or something else? <u>Feed back the participant's answer as something else to imagine:</u> Can you imagine all that again, and this time also imagine that this reminder won't happen, or that you won't notice it, just for the time it takes to complete this exercise?

<u>Repeat this last sub-step up to four additional times or until the participant reports that it felt involuntary.</u>

Okay, this is just your imagination and you can stop imagining that anytime you like, can't you? Please stop imagining that now and open your eyes.

Interlude

<u>Ask the participant to open the survey link, disconnect from the Zoom session, score these first three exercises, complete the next set of exercises, score them, and then re-join the Zoom session:</u>

https://universityofsussex.eu.qualtrics.com/jfe/form/SV_2rghEsMkKcXFXkq

I've placed a URL in the Zoom chat. Please open that, enter the password "imagine" in lower-case, and click the arrow. Then progress through the survey and re-join the Zoom session when you've completed it.

In the survey there is a recording of me giving you a few more exercises, but I present them as descriptions of events that are happening. For example, instead of asking you to move your hands together, I could have told you that they were coming together all by themselves.

When I give you these descriptions, I'd like you to apply the same strategies and approaches to imagination as you have just done: I'd like you to make the scenarios happen, and also imagine

that you're not aware that you're involved in the processes, as if they're happening all by themselves; and if you're reminded that you're causing the behaviour, that you will also imagine that those reminders will disappear or that you won't notice them, just for the time it takes to complete each exercise.

I'd like you to imagine these things in response to these descriptions, just as you did with the previous scenarios, by working out the things that you need to imagine to make the scenarios happen in such a way that they feel involuntary. Do you have any questions about that?

Appendix D – PILOT Test Suggestions (Recording provided in survey)

Read out the whole script except for the headings and the parts that are underlined – these are instructions to the experimenter.

Mosquito Hallucination

Please close your eyes.

You have been listening to me very carefully, paying close attention. You may not have noticed a mosquito that has been buzzing, singing as mosquitoes do ... Listen to it now ... hear its high-pitched buzzing as it flies around your right hand... It is landing on your hand ... perhaps it tickles a little bit ... It flies away again ... you hear its high-pitched buzz ... It's back on your hand tickling ... it might bite you ... you don't like this mosquito ... you'd like to get rid of it ... Go ahead, brush it off ... get rid of it if it bothers you…

Allow 5 seconds.

It's gone ... you are no longer bothered ... the mosquito has disappeared.

Arm Immobilisation

Now your left hand should be in your lap. I want you now to think about your left arm and hand. Pay close attention to them. They feel numb and heavy, very heavy. How heavy your left hand feels ... Even as you think about how heavy your left hand is, it grows heavier and heavier ... Your hand is getting heavier ... heavier and heavier ... Your hand is getting heavier, very heavy, as though it were being pressed against your lap. You might like to find out a little later how heavy your hand is ... it seems much too heavy to move ... but in spite of being so heavy, maybe you can move it a little; but maybe it is too heavy even for that ... Why don't you see how heavy it is ... Just try to lift your hand up, just try.

Allow 5 seconds.

That's fine. Now place your hand back in its resting position. Your hand and arm now feel normal again. They are no longer heavy.

Taste Hallucination

I want you to think of something sweet in your mouth. Imagine that you have something sweet-tasting in your mouth, like a little sugar ... and as you think about this sweet taste you can actually begin to experience the sweet taste ... It may at first be faint, but it will grow ... and grow ... Now you begin to notice a sweet taste in your mouth... The sweet taste is increasing... sweeter... and sweeter... It will get stronger. It often takes a few moments for such a taste to reach its full strength... It is now getting stronger... stronger...

Allow 5 seconds.

All right. Now notice that something is happening to that taste. It is changing. You are now beginning to notice a sour taste in your mouth... an acid taste, as if you had some lemon in your mouth, or a little vinegar... the taste in your mouth is getting more and more sour... more acid... more and more sour...

Allow 5 seconds.

All right. Now the sour taste is going away, and your mouth feels just as it did before I mentioned any taste at all. Your mouth is normal now. It's quite normal now.

Arm Rigidity

Please hold your right arm straight out in front of you, and fingers straight out, too... That's right... Right arm, straight out. Think of your arm becoming stiffer and stiffer ... stiff ... very stiff ... as you think of it becoming stiff you will feel it become stiff ... more stiff and rigid, as though your arm were in a splint so the elbow cannot bend ... stiff ... held stiff, so that it cannot bend. A tightly splinted arm cannot bend ... Your arm feels stiff as if tightly splinted ... Test how stiff and rigid it is ... Try to bend it ... try ...

Allow 5 seconds.

That's fine. You probably noticed how your arm became stiffer as you thought of it as stiff, and how much effort it took to bend it. Your arm is no longer at all stiff. Place it back in position.

Music Hallucination

In a few moments, a recording of 'Happy Birthday to You' will be played for you. When the recording starts the volume will be turned way down and you will probably not be able to hear it, or you will hear it very faintly. Then the volume will increase and I want you to indicate when you can hear it satisfactorily by holding up your right hand. When you can hear the music satisfactorily, hold up your right hand. Okay? Here we go ... The recording of 'Happy Birthday to You' has been turned on. This is Level One.

Allow 5 seconds.

Now it is being turned up a little. This is Level Two. Hold your hand up if you can hear it now.

Allow 5 seconds.

And now louder. This is Level Three.

Allow 5 seconds.

And now the loudest setting. This is Level Four. Hold your hand up if you can hear the music now.

Allow 5 seconds.

Now the music has been turned off. There now, there is no longer any music. You can return your hand to its resting position. Now ... just sit back.

Hand Rising

Now your right hand should be in your lap. I want you now to think about your right arm and hand. Pay close attention to them. Notice whether or not they're a little numb, or tingling. Pay close attention to your hand and wrist now. Imagine that something is tied to your wrist, puling it upwards… maybe a rope that is being pulled upwards through a hole in the ceiling - making the arm feel lighter… Now the hand and arm feel light, as if they are being pulled upwards… and as it feels lighter and lighter the hand and arm being to move upwards… as if pulled up… moving… up, up, more and more up… lighter and lighter… the arm is rising effortlessly… up… slowly but surely… up,

up, more and more up... the arm is so light, it rises so easily... You feel it becoming lighter and

lighter... the arm is too light to hold down... it goes up, up, more and more up.

Allow 5 seconds.

That's good... now let your hand go back to its original resting position. Your hand and arm

are now as they were, feeling perfectly normal.

Completion

Thank you for taking part in this study. Do you have any questions that I could answer? Do

you feel like everything is normal and the same as before we started? My email address and my

supervisor's email address are on the study advert; please feel free to get in touch if you have

questions or comments in the future.

I always need more participants so if you know anyone else you might want to take part,

please ask them to sign up in the same way.

Appendix E – MAIN STUDY Introduction Script (Recording provided in questionnaire)

Hello, I'm X. Thank you for volunteering to take part in this study. You are free to stop at any point and no one will be offended if you change your mind or decide that you don't wish to continue. If you choose not to continue, please close the questionnaire browser window or tab and return to this Zoom call to let me know. Please note that you will not receive credit for incomplete questionnaire responses. All that said, there is nothing that we'll do today that should make you feel uncomfortable. Most people find it an enjoyable experience.

There are three parts to this study. First, I'll describe the experiment and ask you to estimate how much effect you think the process will have on your responses. Next, we'll do some practice imagination exercises and then I'll ask you to score your experiences of them. Following those, I'll then give you some more imagination exercises to do and again ask you to score them. It should take less than half an hour in total.

The rest of the study is fully automated. I will place the questionnaire link into the chat window. Please open it, enter the password "imagine" in lower case letters when asked, and then let me know that you've done that.

[Insert survey link]

Wait for confirmation that they have opened the questionnaire.

Great. Now you can exit this Zoom session, work through the questionnaire, and then return to this Zoom session so we can finish.

Wait for participant to return to Zoom session.

Completion

Thank you for taking part in this study. Everything is normal again and as it was before we started. Do you have any questions I can answer? My email address and my supervisor's email address are on the study advert; please feel free to get in touch if you have questions or comments in the future.

I always need more participants so if you know anyone else you might want to take part, please ask them to sign up in the same way.

Appendix F – MAIN STUDY Introduction to Questionnaire Script (Recording provided in questionnaire)

Before we start, I will give you some information about what we're going to do.

Today we're going to do some imagination exercises to see how your powers of imagination can affect your experiences.

When I ask you to imagine things, please do your best to imagine them as well as you can. Imagine those things are actually happening to you; see what you would see, hear what you would hear, and feel what you would feel, as if those things were completely true and real. I'd like you to fully act the part as if those things were real, making whatever movements are necessary for that to be the case, for the duration of each exercise.

I'd like you to immerse yourself fully in these imaginings. Please do not be concerned with how good you think your imagination is. You may surprise yourself with what is possible just through your imagination, regardless of how well you think you can imagine.

I'd like you to understand that you have a very active role in this process. I want you to enjoy these experiences and, most importantly, I want you to engage fully with them, with the aim of them being successful. Most people who really engage with the process have an interesting and fun experience.

When people are asked to imagine things, some of them do so briefly; they see the image or whatever, and then they stop imagining. Others continue to imagine the thing until they are asked to stop imagining it. Today, I'd like you to continue to imagine the things I ask you to until I ask you to stop.

Most people find it easier to imagine these things with their eyes closed, so I'll ask you to do that during the exercises.

And as well as imagining things that aren't real, we can also imagine that we're not aware of certain thoughts or feelings; and as a result, while we're imagining that, we can feel as if those thoughts or feelings are not happening.

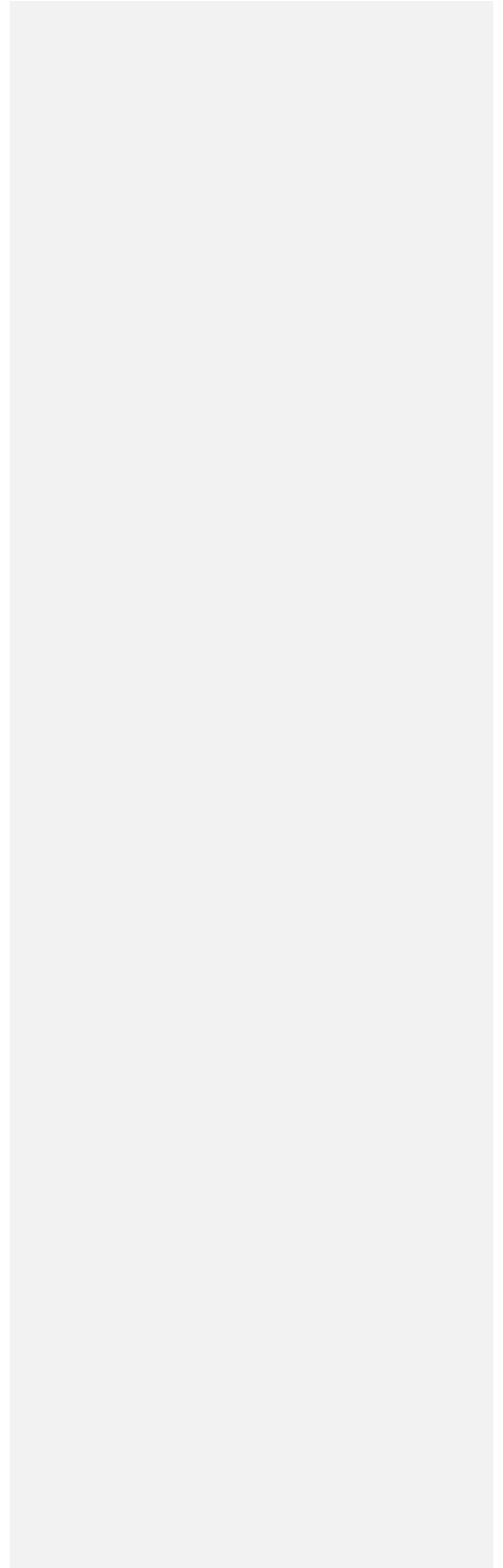All of the effects of this process will not persist beyond the end of our session. I can assure you that you will end the session as exactly the same person you were when we started it, although you may have a memory of an enjoyable experience.

Appendix G – MAIN STUDY 1 Control Group Practice Session (Recording provided in questionnaire)

Read out the whole script except for the headings and the parts that are underlined – these are descriptions of IF-THEN procedures.

Score Expectancy

I will now describe the experiment. I mentioned before that there will be two sets of imagination exercises. The exercises will ask you to make certain experiences feel as if they are happening to you, or happening all by themselves, to the greatest degree that you can. For example, the first exercise involves your hands moving together and the aim is for that to feel as involuntary as possible.

The first set will be a practice session, where I will encourage you to repeat each exercise a number of times, with each time trying to make the experiences feel more involuntary than before. On completion of each exercise, I will ask you to score how much you felt the effect on a Likert scale where zero means you did not feel the effect at all, and five means you felt the effect particularly strongly. I will also ask you to score how involuntary the effect felt on a Likert scale where zero means it felt entirely voluntary and five means it felt entirely involuntary.

In the second set, each exercise will only occur once. These exercises will be similar to the first set, but will differ in terms of the actual experiences being asked for. For those exercises I'd like you to apply everything you've learned in the practice set in order to make those feel as involuntary as possible. I'd like you to now think about how much you think the practice session will affect your scores on this second set. A positive value would indicate that you feel that your average scores on the second set will be higher than if you hadn't engaged in the practice; a negative value would indicate that you feel that your average scores would be lower; and a zero value would indicate that you feel that there would be no change. Please record the average differences that you think would occur now using the sliders on the screen.

Of course, the actual average differences might vary from what you just predicted, and that's fine. It will be interesting to see how your predictions compare with your actual results.

Head Nod

Please close your eyes.

Now please relax as you sit there. I want you to think about your head nodding, as if in agreement, entirely automatically. Simply sitting there quietly and relaxed, your head will begin to nod. All by itself. Allow your head to nod. At first it will be small, almost imperceptible, movements. Forwards and backwards. Head nodding. All by itself. Each nod slightly more significant than the one before. Each nod more obvious. Nod after nod after nod.

Allow 5 seconds.

That's fine. Now please relax and open your eyes.

Please indicate below how involuntary the experience felt, where zero means entirely voluntary and five means entirely involuntary.

If the score is five, move to the next exercise.

Now, the idea is that we're going to try to make that feel involuntary. Do you think that you could make that feel more involuntary if you gave it another try?

If no, move to the next exercise.

Now I'd like you to attempt the same exercise again, but this time make it feel more involuntary. Please make it feel as involuntary as you can.

Repeat the exercise (up to four additional times).

Moving Hands Together

Please close your eyes.

Now extend your arms ahead of you, with palms facing each other, hands about a foot apart. Hold your hands about a foot apart, palms facing each other. I want you to think about a force acting on your hands to pull them together, as though one hand were attracting the other. You are thinking of your hands being pulled together, and they begin to move together... coming together... coming together... moving together... closer together... more and more towards each other... more and more...

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<u>Allow 5 seconds.</u>

That's fine. Now place your hands back in their resting position and open your eyes.

Please indicate below how involuntary the experience felt, where zero means entirely voluntary and five means entirely involuntary.

<u>If the score is five, move to the next exercise.</u>

Now, the idea is that we're going to try to make that feel involuntary. Do you think that you could make that feel more involuntary if you gave it another try?

<u>If no, move to the next exercise.</u>

Now I'd like you to attempt the same exercise again, but this time make it feel more involuntary. Please make it feel as involuntary as you can.

<u>Repeat the exercise (up to four additional times).</u>

Hands Stuck Together

Please close your eyes.

Now extend your arms ahead of you, as before, but with the palms pressed together. I want you now to think about your hands. Pay close attention to them. They are beginning to stick together … Notice that sensation as your hands begin to stick … Your hands are beginning to stick together … Tighter and tighter … More and more stuck. You might like to find out a little later how sticky your hands are … they seem too stuck to separate them … but in spite of how stuck they are, maybe you can move them a little; but maybe they are too stuck for that … Why don't you see how stuck they are … Just try to separate your hands, just try.

<u>Allow 5 seconds.</u>

That's fine. Now place your hands back in their resting positions. Your hands and arms now feel normal again. They are no longer sticky or stuck. Please open your eyes.

Please indicate below how involuntary the experience felt, where zero means entirely voluntary and five means entirely involuntary.

<u>If the score is five, move to the next exercise.</u>

Now, the idea is that we're going to try to make that feel involuntary. Do you think that you could make that feel more involuntary if you gave it another try?

If no, move to the next exercise.

Now I'd like you to attempt the same exercise again, but this time make it feel more involuntary. Please make it feel as involuntary as you can.

Repeat the exercise (up to four additional times).

Interlude

That's the end of the first set of exercises. We will now do the second set. When I give you these descriptions, I'd like you to apply the same strategies and approaches to imagination as you have just done, with the aim of making them feel as involuntary as possible.

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Music Hallucination¶
In a few moments, a recording of 'Happy Birthday to You' will be played for you. When the recording starts the volume will be turned way down and you will probably not be able to hear it, or you will hear it very faintly. Then the volume will increase and I want you to indicate when you can hear it satisfactorily by holding up your right hand. When you can hear the music satisfactorily, hold up your right hand. Okay? Here we go ... The recording of 'Happy Birthday to You' has been turned on. This is Level One.¶
Allow 5 seconds.¶
Now it is being turned up a little. This is Level Two. Hold your hand up if you can hear it now.¶
Allow 5 seconds.¶
And now louder. This is Level Three.¶
Allow 5 seconds.¶
And now the loudest setting. This is Level Four. Hold your hand up if you can hear the music now.¶
Allow 5 seconds.¶
Now the music has been turned off. There now, there is no longer any music. You can return your hand to its resting position. Now ... just sit back.¶
Please open your eyes.¶

Deleted: Ask the participant to open the survey link, disconnect from the Zoom session, score these first three exercises, complete the next set of exercises, score them, and then re-join the Zoom session: ¶
[Insert link to 'control' group questionnaire.]¶
In a moment I will place a URL to a survey in the Zoom chat. In the survey there is a recording of me giving you a few more scenarios to imagine.

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Deleted: Do you have any questions about that?¶
Please open the URL, enter the password "imagine" in lower-case, and click the arrow. Then progress through the survey and re-join the Zoom session when you've completed it.¶

Appendix H – MAIN STUDY 1 Intervention Group Training Session (Recording provided in questionnaire)

Read out the whole script except for the headings and the parts that are underlined – these are descriptions of IF-THEN procedures. The bold part in the following section is purely to indicate the difference with the same text given to the control group.

Score Expectancy

I will now describe the experiment. I mentioned before that there will be two sets of imagination exercises. The exercises will ask you to make certain experiences feel as if they are happening to you, or happening all by themselves, to the greatest degree that you can. For example, the first exercise involves your hands moving together and the aim is for that to feel as involuntary as possible.

The first set will be a practice session, where I will encourage you to repeat each exercise a number of times, with each time trying to make the experiences feel more involuntary than before. **Each time I will ask you to imagine that the exercises feel automatic and involuntary, and to also imagine that you won't be aware of thoughts or feelings that contradict that.** On completion of each exercise, I will ask you to score how much you felt the effect on a Likert scale where zero means you did not feel the effect at all, and five means you felt the effect particularly strongly. I will also ask you to score how involuntary the effect felt on a Likert scale where zero means it felt entirely voluntary and five means it felt entirely involuntary.

In the second set, each exercise will only occur once. These exercises will be similar to the first set, but will differ in terms of the actual experiences being asked for, **and the form in which they are presented**. For those exercises I'd like you to apply everything you've learned in the practice set in order to make those feel as involuntary as possible. I'd like you to now think about how much you think the practice session will affect your scores on this second set. A positive value would indicate that you feel that your average scores on the second set will be higher than if you hadn't engaged in the practice; a negative value would indicate that you feel that your average

scores would be lower; and a zero value would indicate that you feel that there would be no change. Please record the average differences that you think would occur now using the sliders on the screen.

Of course, the actual average differences might vary from what you just predicted, and that's fine. It will be interesting to see how your predictions compare with your actual results.

Training Suggestion 1 – Head Nod

Step 1

Now, please relax as you sit there. Please close your eyes and nod your head forwards and backwards for a few seconds. Please do that now.

Allow 5 seconds.

Great, thanks you can open your eyes and relax again. I imagine that you knew you were making that movement voluntarily.

Step 2

Now, the idea is that we're going to try to make that feel involuntary through the use of imagination. So, I'd like you to do it again, when I indicate, but this time I'd like you to also imagine that you're not involved in the process at all, as if your head is moving all by itself. Please also imagine whatever you think might make it feel more involuntary. Please also imagine that you won't be aware of any thoughts or feelings that would contradict that. Okay, please close your eyes and do that now: relax and nod your head while imagining all of those things.

Allow 5 seconds.

Please open your eyes and relax again. What we're aiming for is for that to feel completely involuntary, as if it was happening all by itself and that you aren't involved in the process.

Please indicate below how involuntary the experience felt, where zero means entirely voluntary and five means entirely involuntary.

If the score is five, move to the next exercise.

Is there anything you could also imagine, anything at all, that might make that feel more involuntary if you gave it another try? For example, some people imagine someone pushing their head forwards and backwards. Others imagine that they won't be aware of their thoughts or feelings related to it.

If no, move to the next exercise.

Now I'd like you to attempt the same exercise again, but this time imagine it feeling more involuntary. Please imagine that it is as involuntary as it could be.

Repeat step 2 of the exercise (up to four additional times).

Training Suggestion 2 – Moving Hands Together

Step 1

Now, please extend your arms ahead of you, with palms facing each other, hands about a foot apart – you can turn to the side if that's more convenient and comfortable. Now, please close your eyes and move your hands together so that they take about 2 seconds to touch. Please do that now.

Allow 5 seconds.

Great, thanks you can open your eyes and relax your hands. I imagine that you knew you were making that movement voluntarily

Step 2

Now, the idea is that we're going to try to make that feel involuntary through the use of imagination. So, I'd like you to do it again, when I indicate, but this time I'd like you to also imagine that you're not involved in the process at all, as if your hands are moving all by themselves. Please also imagine whatever you think might make it feel more involuntary. Please also imagine that you won't be aware of any thoughts or feelings that would contradict that. Okay, please close your eyes and do that now: extend your arms ahead of you and move them together while imagining all of those things.

Allow 5 seconds.

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Deleted: In a moment, when I indicate

Deleted: Mimic moving hands together.¶
Okay, please close your eyes and move your hands together so that they take about 2 seconds to touch.¶
Wait for hands to touch

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Deleted: Can you imagine that while you do this?

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Deleted: Wait for hands to touch

Please open your eyes and relax your hands. What we're aiming for is for that to feel completely involuntary, as if it was happening all by itself and that you aren't involved in the process.

Please indicate below how involuntary the experience felt, where zero means entirely voluntary and five means entirely involuntary.

If the score is five, move to the next exercise.

Is there anything you could also imagine, anything at all, that might make that feel more involuntary if you gave it another try? For example, some people imagine someone pushing their hands together. Others imagine that they won't be aware of their thoughts or feelings related to it.

If no, move to the next exercise.

Now I'd like you to attempt the same exercise again, but this time imagine it feeling more involuntary. Please imagine that it is as involuntary as it could be.

Repeat step 2 of the exercise (up to four additional times).

Training Suggestion 3 – Hands Stuck Together

Step 1

Now extend your arms ahead of you, as before, but with the palms pressed together – again you can turn to the side if that's more convenient and comfortable. Now, please close your eyes and keep your hands together but do everything you can to try to pull them apart. What I mean, is don't let your hands separate, but enact all the muscles and strength you can to try to separate them, right up to the point where they would separate. Please do that now

Wait for 5 seconds.

Great, thanks you can open your eyes and relax your hands. I imagine that you knew you were doing that voluntarily

Step 2

Now, the idea is that we're going to try to make that feel involuntary through the use of imagination. So, I'd like you to do it again, when I indicate, but this time I'd like you to also imagine

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Deleted: Did that feel like it was happening to you?

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If they report that it felt volitional, or if they do not have something they could imagine that would make it feel involuntary: How did you know you were moving your hands? Was it something you thought, something you felt, or something else? Feed back the participant's answer as something else to imagine: Can you imagine all that again, and this time also imagine that this reminder won't happen, or that you won't notice it, just for the time it takes to complete this exercise?¶
Repeat this last sub-step up to four additional times or until the participant reports that it felt involuntary. ¶
Okay, this is just your imagination and you can stop imagining that anytime you like, can't you? Please stop imagining that now and open your eyes.¶

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Deleted: In a moment, when I indicate

Deleted: Does that make sense?

Deleted: Mimic hands stuck together.¶
Okay, please close your eyes and keep your hands together while doing your best to separate them.¶

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that you're not involved in the process at all, as if your hands cannot be separated all by themselves.

Please also imagine whatever you think might make it feel more involuntary. Please also imagine that you won't be aware of any thoughts or feelings that would contradict that. Okay, please close your eyes and do that now: keep your hands together but do everything you can to try to pull them apart while imagining all of those things.

Wait for 5 seconds.

Please open your eyes and relax your hands. What we're aiming for is for that to feel completely involuntary, as if it was happening all by itself and that you aren't involved in the process.

Please indicate below how involuntary the experience felt, where zero means entirely voluntary and five means entirely involuntary.

If the score is five, move to the next exercise.

Is there anything you could also imagine, anything at all, that might make that feel more involuntary if you gave it another try? For example, some people imagine someone holding their hands together. Others imagine that they won't be aware of their thoughts or feelings related to it.

If no, move to the next exercise.

Now I'd like you to attempt the same exercise again, but this time imagine it feeling more involuntary. Please imagine that it is as involuntary as it could be.

Repeat step 2 of the exercise (up to four additional times).

Interlude

That's the end of the first set of exercises. We will now do the second set. These are similar to the exercises we have just done, but I present them as descriptions of events that are happening. For example, instead of asking you to move your hands together, I could have told you that they were coming together all by themselves.

When I give you these descriptions, I'd like you to apply the same strategies and approaches to imagination as you have just done: I'd like you to make the scenarios happen, including imagining

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Deleted: Can you imagine that while you do this? Okay, please do that now.

Deleted: Did that feel like it was happening to you?

Deleted: If they report that it felt volitional, or if they do not have something they could imagine that would make it feel involuntary: How did you know you were stopping your hands moving? Was it something you thought, something you felt, or something else? Feed back the participant's answer as something else to imagine: Can you imagine all that again, and this time also imagine that this reminder won't happen, or that you won't notice it, just for the time it takes to complete this exercise?¶
Repeat this last sub-step up to four additional times or until the participant reports that it felt involuntary.¶
Okay, this is just your imagination and you can stop imagining that anytime you like, can't you? Please stop imagining that now and open your eyes.¶
Training Suggestion 3 – Music Hallucination¶
Step 1¶
What I'd like you to do, with your eyes closed, is to imagine that a recording of 'Happy Birthday to You' is being played for you. Imagine it as if it is really happening in the room. Let me know when you have a good impression of that and can hear it playing in your imagination.¶
Wait for their signal. If no signal after 10 seconds, continue.¶
Great, thanks you can open your eyes. I imagine that you knew you were imagining that sound voluntarily?¶
Step 2¶
Now, the idea is that we're going to try to make that feel involuntary through the use of imagination. So, I'd like you to do it again, when I indicate, but this time I'd like you to also imagine that you're not involved in the process at all, as if the music is happening all by itself. Can you imagine that while you do this? Okay, please do that now and let me know when you've done that.¶
Wait for them to signal. If no signal after 10 seconds, continue.¶
What we're aiming for is for that to feel completely involuntary, as if it was happening all by itself and that you aren't involved in the process. Did that feel like it was happening to you?¶
If they report that it felt volitional, or if they do not have something they could imagine that would make it feel involuntary: How did you know you were imagining? Was it something you thought, something you felt, or something else? Feed back the participant's answer as something else to imagine: Can you imagine all that again, and this time also imagine that this reminder won't happen, or tha … [10]

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Deleted: Ask the participant to open the survey link, disconnect from the Zoom session, score these first three exercises, complete the next set of exercises, score them, and then re-join the Zoom session:
[Insert link to 'active' group questionnaire.]¶
In a moment I will place a URL to a survey in the Zoom chat. In the survey there is a recording of me giving you a few more exercises,

things that aren't real but are suggested to be the case, imagining that they are actually happening

to you, and also imagine that you're not aware that you're involved in the processes, as if they're

happening all by themselves; and if you're reminded that you're causing the behaviour, that you will

also imagine that those reminders will disappear or that you won't notice them, just for the time it

takes to complete each exercise.

I'd like you to imagine these things in response to these descriptions, just as you did with the

previous scenarios, by working out the things that you need to imagine to make the scenarios

happen in such a way that they feel involuntary.

Deleted: Do you have any questions about that?¶
Please open the URL, enter the password "imagine" in lower-case, and click the arrow. Then progress through the survey and re-join the Zoom session when you've completed it.

Appendix L – MAIN STUDY 1 Test Suggestions (Recording provided in questionnaire)

Read out the whole script except for the headings and the parts that are underlined – these are instructions to the experimenter.

Hand Lowering

Please close your eyes and keep them closed until I ask you to open them.

Now hold your right hand out at shoulder height, with the palm of your hand facing up. Your right hand straight out in front of you, the palm up. There, that's right.... Attend carefully to this hand, how it feels, what's going on in it. Notice whether or not it's a little numb, or tingling; the slight effort it takes to keep from bending your wrist; any breeze blowing on it. Pay close attention to your hand now. Imagine that you are holding something heavy in your hand... maybe a heavy bowling ball - something heavy. Shape your fingers around as though you were holding this heavy object that you imagine is in your hand. That's it.... Now the hand and arm feel heavy, as if the weight were pressing down...and as it feels heavier and heavier the hand and arm begin to move down... as if forced down... moving... moving... down... down... more and more down... heavier... heavier... the arm is getting more and more tired and strained... down... slowly but surely... down, down... more and more down, the weight is so great, the hand is so heavy... You feel the weight more and more... the arm is too heavy to hold back... it goes down, down... more and more down...

Allow 5 seconds.

That's good... now let your hand go back to its original resting position. You probably experienced much more heaviness and tiredness in your arm than you would have if you had not concentrated on it and had not imagined something trying to force it down. Your hand and arm are now as they were, not feeling tired or strained....

Arm Immobilisation

Now your left hand should be in your lap. I want you now to think about your left arm and hand. Pay close attention to them. They feel numb and heavy, very heavy. How heavy your left hand

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Deleted: Mosquito Hallucination¶
You have been listening to me very carefully, paying close attention. You may not have noticed a mosquito that has been buzzing, singing as mosquitoes do ... Listen to it now ... hear its high-pitched buzzing as it flies around your right hand... It is landing on your hand ... perhaps it tickles a little bit ... It flies away again ... you hear its high pitched buzz ... It's back on your hand tickling ... it might bite you ... you don't like this mosquito ... you'd like to get rid of it ... Go ahead, brush it off ... get rid of it if it bothers you...¶
Allow 5 seconds.¶
It's gone ... you are no longer bothered ... the mosquito has disappeared. ¶

feels ... Even as you think about how heavy your left hand is, it grows heavier and heavier ... Your hand is getting heavier ... heavier and heavier ... Your hand is getting heavier, very heavy, as though it were being pressed against your lap. You might like to find out a little later how heavy your hand is ... it seems much too heavy to move ... but in spite of being so heavy, maybe you can move it a little; but maybe it is too heavy even for that ... Why don't you see how heavy it is ... Just try to lift your hand up, just try.

Allow 5 seconds.

That's fine. Now place your hand back in its resting position. Your hand and arm now feel normal again. They are no longer heavy.

Hand Rising

Now your right hand should be in your lap. I want you now to think about your right arm and hand. Pay close attention to them. Notice whether or not they're a little numb, or tingling. Pay close attention to your hand and wrist now. Imagine that something is tied to your wrist, puling it upwards… maybe a rope that is being pulled upwards through a hole in the ceiling - making the arm feel lighter… Now the hand and arm feel light, as if they are being pulled upwards… and as it feels lighter and lighter the hand and arm being to move upwards… as if pulled up… moving… up, up, more and more up… lighter and lighter… the arm is rising effortlessly… up… slowly but surely… up, up, more and more up… the arm is so light, it rises so easily… You feel it becoming lighter and lighter… the arm is too light to hold down… it goes up, up, more and more up.

Allow 5 seconds.

That's good… now let your hand go back to its original resting position. Your hand and arm are now as they were, feeling perfectly normal.

Arm Rigidity

Please hold your right arm straight out in front of you, and fingers straight out, too... That's right... Right arm, straight out. Think of your arm becoming stiffer and stiffer ... stiff ... very stiff ... as you think of it becoming stiff you will feel it become stiff ... more stiff and rigid, as though

your arm were in a splint so the elbow cannot bend … stiff … held stiff, so that it cannot bend. A

tightly splinted arm cannot bend … Your arm feels stiff as if tightly splinted … Test how stiff and

rigid it is … Try to bend it … try …

> Allow 5 seconds.

That's fine. You probably noticed how your arm became stiffer as you thought of it as stiff,

and how much effort it took to bend it. Your arm is no longer at all stiff. Place it back in position.

Please open your eyes.

Completion

Thank you for taking part in this study. Everything is normal again and as it was before we

started. Please now exit this questionnaire and return to the original Zoom session.

Deleted: Hand Rising¶
Now your right hand should be in your lap. I want you now to think about your right arm and hand. Pay close attention to them. Notice whether or not they're a little numb, or tingling. Pay close attention to your hand and wrist now. Imagine that something is tied to your wrist, puling it upwards… maybe a rope that is being pulled upwards through a hole in the ceiling - making the arm feel lighter… Now the hand and arm feel light, as if they are being pulled upwards… and as it feels lighter and lighter the hand and arm being to move upwards… as if pulled up… moving… up, up, more and more up… lighter and lighter… the arm is rising effortlessly… up… slowly but surely… up, up, more and more up… the arm is so light, it rises so easily… You feel it becoming lighter and lighter… the arm is too light to hold down… it goes up, up, more and more up.¶
Allow 5 seconds.¶
That's good… now let your hand go back to its original resting position. Your hand and arm are now as they were, feeling perfectly normal.¶

Deleted: Do you have any questions that I could answer? Do you feel like everything is normal and the same as before we started? My email address and my supervisor's email address are on the study advert; please feel free to get in touch if you have questions or comments in the future.¶
I always need more participants so if you know anyone else you might want to take part, please ask them to sign up in the same way.

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Appendix J – MAIN STUDY 2 Control Group Practice Session (Recording provided in questionnaire)

Read out the whole script except for the headings and the parts that are underlined – these are descriptions of IF-THEN procedures.

Score Expectancy

I will now describe the experiment. I mentioned before that there will be two sets of imagination exercises. The exercises will ask you to make certain experiences feel as if they are happening to you, or happening all by themselves, to the greatest degree that you can. For example, the first exercise involves your hands moving together and the aim is for that to feel as involuntary as possible.

The first set will be a practice session, where I will encourage you to repeat each exercise a number of times, with each time trying to make the experiences feel more involuntary than before. On completion of each exercise, I will ask you to score how much you felt the effect on a Likert scale where zero means you did not feel the effect at all, and five means you felt the effect particularly strongly. I will also ask you to score how involuntary the effect felt on a Likert scale where zero means it felt entirely voluntary and five means it felt entirely involuntary.

In the second set, each exercise will only occur once. These exercises will be similar to the first set, but will differ in terms of the actual experiences being asked for. For those exercises I'd like you to apply everything you've learned in the practice set in order to make those feel as involuntary as possible. I'd like you to now think about how much you think the practice session will affect your scores on this second set. A positive value would indicate that you feel that your average scores on the second set will be higher than if you hadn't engaged in the practice; a negative value would indicate that you feel that your average scores would be lower; and a zero value would indicate that you feel that there would be no change. Please record the average differences that you think would occur now using the sliders on the screen.

Of course, the actual average differences might vary from what you just predicted, and that's fine. It will be interesting to see how your predictions compare with your actual results.

Moving Hands Together

Please close your eyes.

Now extend your arms ahead of you, with palms facing each other, hands about a foot apart. Hold your hands about a foot apart, palms facing each other. I want you to think about a force acting on your hands to pull them together, as though one hand were attracting the other. You are thinking of your hands being pulled together, and they begin to move together... coming together... coming together... moving together... closer together... more and more towards each other... more and more...

Allow 5 seconds.

That's fine. Now place your hands back in their resting position and open your eyes.

Please indicate below how involuntary the experience felt, where zero means entirely voluntary and five means entirely involuntary.

If the score is five, move to the next exercise.

Now, the idea is that we're going to try to make that feel involuntary. Do you think that you could make that feel more involuntary if you gave it another try?

If no, move to the next exercise.

Now I'd like you to attempt the same exercise again, but this time make it feel more involuntary. Please make it feel as involuntary as you can.

Repeat the exercise (up to four additional times).

Hands Stuck Together

Please close your eyes.

Now extend your arms ahead of you, as before, but with the palms pressed together. I want you now to think about your hands. Pay close attention to them. They are beginning to stick together … Notice that sensation as your hands begin to stick … Your hands are beginning to stick together … Tighter and tighter … More and more stuck. You might like to find out a little later how sticky your hands are … they seem too stuck to separate them … but in spite of how stuck they are,

maybe you can move them a little; but maybe they are too stuck for that … Why don't you see how stuck they are … Just try to separate your hands, just try.

Allow 5 seconds.

That's fine. Now place your hands back in their resting positions. Your hands and arms now feel normal again. They are no longer sticky or stuck. Please open your eyes.

Please indicate below how involuntary the experience felt, where zero means entirely voluntary and five means entirely involuntary.

If the score is five, move to the next exercise.

Now, the idea is that we're going to try to make that feel involuntary. Do you think that you could make that feel more involuntary if you gave it another try?

If no, move to the next exercise.

Now I'd like you to attempt the same exercise again, but this time make it feel more involuntary. Please make it feel as involuntary as you can.

Repeat the exercise (up to four additional times).

Music Hallucination

Please close your eyes.

In a few moments, a recording of 'Happy Birthday to You' will be played for you. When the recording starts the volume will be turned way down and you will probably not be able to hear it, or you will hear it very faintly. Then the volume will increase and I want you to indicate when you can hear it satisfactorily by holding up your right hand. When you can hear the music satisfactorily, hold up your right hand. Okay? Here we go ... The recording of 'Happy Birthday to You' has been turned on. This is Level One.

Allow 5 seconds.

Now it is being turned up a little. This is Level Two. Hold your hand up if you can hear it now.

Allow 5 seconds.

And now louder. This is Level Three.

Allow 5 seconds.

And now the loudest setting. This is Level Four. Hold your hand up if you can hear the music now.

Allow 5 seconds.

Now the music has been turned off. There now, there is no longer any music. You can return your hand to its resting position. Now ... just sit back.

Please open your eyes.

Please indicate below how involuntary the experience felt, where zero means entirely voluntary and five means entirely involuntary.

If the score is five, move to the next section.

Now, the idea is that we're going to try to make that feel involuntary. Do you think that you could make that feel more involuntary if you gave it another try?

If no, move to the next section.

Now I'd like you to attempt the same exercise again, but this time make it feel more involuntary. Please make it feel as involuntary as you can.

Repeat the exercise (up to four additional times).

Negative Hallucination for Black Circle

Please close your eyes.

In a few moments, when I indicate, I will ask you to open your eyes and to look at the questionnaire window for a few seconds until I ask you to close them again. Please keep your eyes closed until I indicate. When I ask you to open your eyes and look at the questionnaire window, you will see that whatever is on it is slowly but surely disappearing and that it is becoming completely white … completely white … with nothing else on it. When I ask you to open your eyes, you will look at the questionnaire window and see that it is becoming completely white and that there is nothing else on it. Okay I will count to three. On the count of three please open your eyes and look at the questionnaire window and see that it is becoming completely white. 1, 2, 3, please open your eyes.

The questionnaire screen should show a prominent black circle on a white background.

Allow 5 seconds.

Please close your eyes. Everything is normal again. When you open your eyes, you will see what you would usually see. Completely normal. Okay, please open your eyes.

Please indicate below how involuntary the experience felt, where zero means entirely voluntary and five means entirely involuntary.

If the score is five, move to the next section.

Now, the idea is that we're going to try to make that feel involuntary. Do you think that you could make that feel more involuntary if you gave it another try?

If no, move to the next section.

Now I'd like you to attempt the same exercise again, but this time make it feel more involuntary. Please make it feel as involuntary as you can.

Repeat the exercise (up to four additional times).

Interlude

That's the end of the first set of exercises. We will now do the second set. When I give you these descriptions, I'd like you to apply the same strategies and approaches to imagination as you have just done, with the aim of making them feel as involuntary as possible.

Appendix K – MAIN STUDY 2 Intervention Group Training Session (Recording provided in

questionnaire)

Read out the whole script except for the headings and the parts that are underlined – these

are descriptions of IF-THEN procedures. The bold part in the following section is purely to indicate

the difference with the same text given to the control group.

Score Expectancy

I will now describe the experiment. I mentioned before that there will be two sets of

imagination exercises. The exercises will ask you to make certain experiences feel as if they are

happening to you, or happening all by themselves, to the greatest degree that you can. For example,

the first exercise involves your hands moving together and the aim is for that to feel as involuntary

as possible.

The first set will be a practice session, where I will encourage you to repeat each exercise a

number of times, with each time trying to make the experiences feel more involuntary than before.

Each time I will ask you to imagine that the exercises feel automatic and involuntary, and to also

imagine that you won't be aware of thoughts or feelings that contradict that. On completion of

each exercise, I will ask you to score how much you felt the effect on a Likert scale where zero

means you did not feel the effect at all, and five means you felt the effect particularly strongly. I will

also ask you to score how involuntary the effect felt on a Likert scale where zero means it felt

entirely voluntary and five means it felt entirely involuntary.

In the second set, each exercise will only occur once. These exercises will be similar to the

first set, but will differ in terms of the actual experiences being asked for**, and the form in which**

they are presented. For those exercises I'd like you to apply everything you've learned in the

practice set in order to make those feel as involuntary as possible. I'd like you to now think about

how much you think the practice session will affect your scores on this second set. A positive value

would indicate that you feel that your average scores on the second set will be higher than if you

hadn't engaged in the practice; a negative value would indicate that you feel that your average

scores would be lower; and a zero value would indicate that you feel that there would be no change. Please record the average differences that you think would occur now using the sliders on the screen.

Of course, the actual average differences might vary from what you just predicted, and that's fine. It will be interesting to see how your predictions compare with your actual results.

Training Suggestion 1 – Moving Hands Together

Step 1

Now, please extend your arms ahead of you, with palms facing each other, hands about a foot apart – you can turn to the side if that's more convenient and comfortable. Now, please close your eyes and move your hands together so that they take about 2 seconds to touch. Please do that now.

Allow 5 seconds.

Great, thanks you can open your eyes and relax your hands. I imagine that you knew you were making that movement voluntarily.

Step 2

Now, the idea is that we're going to try to make that feel involuntary through the use of imagination. So, I'd like you to do it again, when I indicate, but this time I'd like you to also imagine that you're not involved in the process at all, as if your hands are moving all by themselves. Please also imagine whatever you think might make it feel more involuntary. Please also imagine that you won't be aware of any thoughts or feelings that would contradict that. Okay, please close your eyes and do that now: extend your arms ahead of you and move them together while imagining all of those things.

Allow 5 seconds.

Please open your eyes and relax your hands. What we're aiming for is for that to feel completely involuntary, as if it was happening all by itself and that you aren't involved in the process.

Please indicate below how involuntary the experience felt, where zero means entirely voluntary and five means entirely involuntary.

If the score is five, move to the next exercise.

Is there anything you could also imagine, anything at all, that might make that feel more involuntary if you gave it another try? For example, some people imagine someone pushing their hands together. Others imagine that they won't be aware of their thoughts or feelings related to it.

If no, move to the next exercise.

Now I'd like you to attempt the same exercise again, but this time imagine it feeling more involuntary. Please imagine that it is as involuntary as it could be.

Repeat step 2 of the exercise (up to four additional times).

Training Suggestion 2 – Hands Stuck Together

Step 1

Now extend your arms ahead of you, as before, but with the palms pressed together – again you can turn to the side if that's more convenient and comfortable. Now, please close your eyes and keep your hands together but do everything you can to try to pull them apart. What I mean, is don't let your hands separate, but enact all the muscles and strength you can to try to separate them, right up to the point where they would separate. Please do that now.

Wait for 5 seconds.

Great, thanks you can open your eyes and relax your hands. I imagine that you knew you were doing that voluntarily.

Step 2

Now, the idea is that we're going to try to make that feel involuntary through the use of imagination. So, I'd like you to do it again, when I indicate, but this time I'd like you to also imagine that you're not involved in the process at all, as if your hands cannot be separated all by themselves. Please also imagine whatever you think might make it feel more involuntary. Please also imagine that you won't be aware of any thoughts or feelings that would contradict that. Okay, please close

your eyes and do that now: keep your hands together but do everything you can to try to pull them apart while imagining all of those things.

Wait for 5 seconds.

Please open your eyes and relax your hands. What we're aiming for is for that to feel completely involuntary, as if it was happening all by itself and that you aren't involved in the process.

Please indicate below how involuntary the experience felt, where zero means entirely voluntary and five means entirely involuntary.

If the score is five, move to the next exercise.

Is there anything you could also imagine, anything at all, that might make that feel more involuntary if you gave it another try? For example, some people imagine someone holding their hands together. Others imagine that they won't be aware of their thoughts or feelings related to it.

If no, move to the next exercise.

Now I'd like you to attempt the same exercise again, but this time imagine it feeling more involuntary. Please imagine that it is as involuntary as it could be.

Repeat step 2 of the exercise (up to four additional times).

Training Suggestion 3 – Music Hallucination

Step 1

What I'd like you to do, with your eyes closed, is to imagine that a recording of 'Happy Birthday to You' is being played for you. Imagine it as if it is really happening in the room. Please do that now.

Allow 5 seconds.

Great, thanks you can open your eyes. I imagine that you knew you were imagining that sound voluntarily.

Step 2

Now, the idea is that we're going to try to make that feel involuntary through the use of imagination. So, I'd like you to do it again, when I indicate, but this time I'd like you to also imagine that you're not involved in the process at all, as if the music is happening all by itself. Please also imagine whatever you think might make it feel more involuntary. Please also imagine that you won't be aware of any thoughts or feelings that would contradict that. Okay, please close your eyes and do that now: imagine that a recording of 'Happy Birthday to You' is being played for you while imagining all of those things.

Allow 5 seconds.

Please open your eyes. What we're aiming for is for that to feel completely involuntary, as if it was happening all by itself and that you aren't involved in the process.

Please indicate below how involuntary the experience felt, where zero means entirely voluntary and five means entirely involuntary.

If the score is five, move to the next section.

Is there anything you could also imagine, anything at all, that might make that feel more involuntary if you gave it another try? For example, some people imagine someone singing it to them. Others imagine that they won't be aware of their thoughts or feelings related to imagining it.

If no, move to the next section.

Now I'd like you to attempt the same exercise again, but this time imagine it feeling more involuntary. Please imagine that it is as involuntary as it could be.

Repeat step 2 of the exercise (up to four additional times).

Training Suggestion 4 – Negative Hallucination for Black Circle

Step 1

What I'd like you to do, with your eyes closed, is to imagine that when you open them and look at the questionnaire window – don't open them yet – that when you look at the questionnaire window that it will slowly but surely become completely white … completely white … with nothing

else on it. And when you do open your eyes and look at the questionnaire window, that you will continue to imagine that it is becoming completely white with nothing else on it. Okay I will count to three. On the count of three please open your eyes and look at the questionnaire window and imagine that it is becoming completely white. 1, 2, 3, please open your eyes.

The questionnaire screen should show a prominent black circle on a white background. Allow 5 seconds.

Great, thanks you can close your eyes and stop imagining that. And now open your eyes. I imagine that you knew you were imagining that voluntarily.

Step 2

Now, the idea is that we're going to try to make that feel involuntary through the use of imagination. So, I'd like you to do it again, when I indicate, but this time I'd like you to also imagine that you're not involved in the process at all, as if the imagining is happening all by itself. Please also imagine whatever you think might make it feel more involuntary. Please also imagine that you won't be aware of any thoughts or feelings that would contradict that. Okay, please close your eyes and do that now: imagine that when you open your eyes the questionnaire window will become completely white. Okay I will count to three. On the count of three please open your eyes and look at the questionnaire window and imagine that it is becoming completely white. 1, 2, 3, please open your eyes.

The questionnaire screen should show a prominent black circle on a white background. Allow 5 seconds.

Please close your eyes and stop imagining that. And now open your eyes. What we're aiming for is for that to feel completely involuntary, as if it was happening all by itself and that you aren't involved in the process.

Please indicate below how involuntary the experience felt, where zero means entirely voluntary and five means entirely involuntary.

If the score is five, move to the next section.

Is there anything you could also imagine, anything at all, that might make that feel more involuntary if you gave it another try? For example, some people imagine they are looking at a different window that is completely white. Others imagine that they won't be aware of their thoughts or feelings related to imagining it.

If no, move to the next section.

Now I'd like you to attempt the same exercise again, but this time imagine it feeling more involuntary. Please imagine that it is as involuntary as it could be.

Repeat step 2 of the exercise (up to four additional times).

Interlude

That's the end of the first set of exercises. We will now do the second set. These are similar to the exercises we have just done, but I present them as descriptions of events that are happening. For example, instead of asking you to move your hands together, I could have told you that they were coming together all by themselves.

When I give you these descriptions, I'd like you to apply the same strategies and approaches to imagination as you have just done: I'd like you to make the scenarios happen, including imagining things that aren't real but are suggested to be the case, imagining that they are actually happening to you, and also imagine that you're not aware that you're involved in the processes, as if they're happening all by themselves; and if you're reminded that you're causing the behaviour, that you will also imagine that those reminders will disappear or that you won't notice them, just for the time it takes to complete each exercise.

I'd like you to imagine these things in response to these descriptions, just as you did with the previous scenarios, by working out the things that you need to imagine to make the scenarios happen in such a way that they feel involuntary.

Appendix L – MAIN STUDY 2 Test Suggestions (Recording provided in questionnaire)

Read out the whole script except for the headings and the parts that are underlined – these are instructions to the experimenter.

Mosquito Hallucination

You have been listening to me very carefully, paying close attention. You may not have noticed a mosquito that has been buzzing, singing as mosquitoes do ... Listen to it now ... hear its high-pitched buzzing as it flies around your right hand... It is landing on your hand ... perhaps it tickles a little bit ... It flies away again ... you hear its high pitched buzz ... It's back on your hand tickling ... it might bite you ... you don't like this mosquito ... you'd like to get rid of it ... Go ahead, brush it off ... get rid of it if it bothers you...

Allow 5 seconds.

It's gone ... you are no longer bothered ... the mosquito has disappeared.

Taste Hallucination

I want you to think of something sweet in your mouth. Imagine that you have something sweet-tasting in your mouth, like a little sugar ... and as you think about this sweet taste you can actually begin to experience the sweet taste ... It may at first be faint, but it will grow ... and grow ... Now you begin to notice a sweet taste in your mouth... The sweet taste is increasing... sweeter... and sweeter... It will get stronger. It often takes a few moments for such a taste to reach its full strength... It is now getting stronger... stronger...

Allow 5 seconds.

All right. Now notice that something is happening to that taste. It is changing. You are now beginning to notice a sour taste in your mouth... an acid taste, as if you had some lemon in your mouth, or a little vinegar... the taste in your mouth is getting more and more sour... more acid... more and more sour...

Allow 5 seconds.

All right. Now the sour taste is going away, and your mouth feels just as it did before I mentioned any taste at all. Your mouth is normal now. It's quite normal now.

Negative Sound Hallucination

In a moment when I indicate, I and the recording will get progressively quieter and will eventually make no sound at all. No sound at all. But not until I indicate. Then any sounds or music that you hear will get quieter and quieter and then vanish completely. After five seconds I will indicate that you will be able to hear the recording as normal. So, when I indicate, but not yet, the recording will get progressively quieter and then become completely silent. Any sounds that you hear will get quieter and quieter and then vanish completely. And then after five seconds I will indicate that you will be able to hear the recording as normal. Okay, I will count to three and then everything will go silent for five seconds. 1, 2, 3.

The questionnaire should play sounds for five seconds.

Okay now everything is back to normal and you can hear the recording normally. Everything normal again.

Draining Colour Hallucination

In a moment when I indicate, I would like you to open your eyes and look at the questionnaire window. Please keep your eyes closed until I indicate. When I do ask you to open your eyes, I'd like you to look at the questionnaire window. On the screen will be an image and slowly but surely the colour will reduce so eventually there will be no colour in it at all. It will be made up entirely of shades of grey and black and white. No colour at all. So, in a moment when I ask you to open your eyes – please keep them closed until then – you will look at the questionnaire window and see an image with its colour reducing until there is no colour in it at all. It will be entirely black, white and grey. Okay, I will count to three and then I'd like you to open your eyes and look at the screen and see the image with its colour reducing until there is no colour at all. 1, 2, 3, open your eyes.

The questionnaire screen should show a prominent colourful image on a white background.

Allow 5 seconds.

Please close your eyes. Everything is normal again. When you open your eyes, you will see what you would usually see, in all the colours it would normally be. Completely normal. Okay, please open your eyes.

Completion

Thank you for taking part in this study. Everything is normal again and as it was before we started. Please now exit this questionnaire and return to the original Zoom session.

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Appendix M – Determining *N* for Pre-registered Experiments

While the pilot study found the data to be insensitive regarding evidence, the post-hoc analysis showed that had the hallucination suggestions been removed, or had the training generalised to hallucination suggestions, then the data would have indicated moderate evidence for the alternative hypothesis, supporting the training. In order to calculate the number of participants required for the pre-registered experiment (based on the pilot experiment), we used the values from the post-hoc analysis with the intention of obtaining a Bayes factor greater than five or less than one fifth. By aiming for Bayes factors greater than a threshold of three or less than one third (the standard thresholds for Bayesian analyses; see Dienes, 2019) we seek to make the results more robust, allowing for a range *SD*s of the model of H_1 to agree with final conclusions.

Our initial calculations used a heuristic to simplify the process of obtaining quick estimates of the *N*s needed for a 50% probability of exceeding thresholds, should the relevant hypothesis be true (Dienes, 2015; Palfi & Dienes, 2019, version 3). We assumed that the standard errors for the pre-registered experiment would be consistent with the calculated standard errors in the pilot post-hoc analysis. Using this heuristic, we calculated that $N=64$ would result in Bayes factor $B > 5$ for both the subjective realness and involuntariness measures, assuming the same mean differences and standard errors as the post-hoc analysis. We further calculated that requiring a Bayes factor $B < 1/5$ for a mean difference of 0 would require in excess of 300 participants; but that a Bayes factor $B < 1/3$ could be achieved with 112 participants.

Following feedback from a reviewer, we recalculated these parameters using Monte Carlo simulations (1000 rounds each), sampling the standard error each time to take into account measurement uncertainty in the standard error (using a scaled inverse chi-squared distribution for variance, which can be used to either provide frequentist confidence intervals on a variance, or a Bayesian posterior distribution of a variance assuming a vague prior). These simulations revealed that for subjective and involuntariness measures, obtaining $B > 5$ would be possible with 80% probability when $N=73$. Obtaining $B < 1/5$ with 80% power would require $N=387$; but $B < 1/3$ with

80% power only required N=130. These results indicate that the original heuristic gave reasonable estimates (though establishing that generally would require a proper study of the correspondences), and even requiring a higher probability of exceeding threshold (80% vs 50%) did not result in many more participants needed when uncertainty is taken into account for the standard error.

Code

The following R code was used to generate the simulation. The *sample_bf* function samples the variance from a scaled inverse chi-squared distribution, where the scale (variance) was calculated from the supplied standard error squared. The resultant variance is then converted to a standard error and scaled according to the square root of the ratio of the new N to the original N. This sampled and scaled standard error is then used to calculate a Bayes factor, based on the new N, the model of H_1 and H_0. The *CalcBayesFactor* function and the *nullPrior* variable have not been duplicated here for brevity.

The *simulate_bf* function simply obtains a Bayes factor (from *sample_bf*) based on a modified N and a sampled standard error, and then checks whether it meets the supplied threshold. The threshold is specified as a function that takes a Bayes factor and returns a Boolean. The *sim_bf_prob* function runs the Monte Carlo simulation, building a vector of Boolean results with each value representing a single run. It returns the proportion that exceeded the specified Bayes threshold.

The *binwalk_bf_find_n* function uses the Monte Carlo simulation (*sim_bf_prob*) to find a suitable value for N via a binary search of the specified space.

```
# sample_bf samples the SE and calculates a Bayes factor using it,
# scaled to modified n
sample_bf <- function(orig_se, meandiff, altprior, orig_n, n) {
  tau_sqr <- orig_se * orig_se # tau^2 is variance
  se_sample <- sqrt(rinvchisq(1, orig_n, tau_sqr)) # samples are variance
  se <- se_sample * sqrt(orig_n / n) # scale SE according to change in n
  # calculate Bayes factor
  CalcBayesFactor(meandiff, se, n/2, n/2, "student_t", nullPrior, altprior)
}
```

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```r
# bayestest is a function that takes a single numeric argument and returns a Boolean.

# simulate_bf calculates a single Bayes factor using sampled SE and tests it with a given
function
simulate_bf <- function(orig_se, meandiff, altprior, orig_n, n, bayestest) {
  bf <- sample_bf(orig_se, meandiff, altprior, orig_n, n)
  bayestest(bf)
}

# sim_bf_power calculates a set of Bayes factors using sampled SEs,
# tests them with the given function
# and returns the proportion that passed the given test (Monte Carlo simulation)
sim_bf_prob <- function(orig_se, meandiff, altprior, orig_n, n, bayestest, reps) {
  out = matrix(NA, reps, 1)
  for (i in 1:reps) {
    out[i] <- simulate_bf(orig_se, meandiff, altprior, orig_n, n, bayestest)
  }
  mean(out)
}

# binwalk_bf_find_n uses the Monte Carlo simulation provided by sim_bf_prob
# to find the minimum N that achieves the specified probability.
# Example:
# > binwalk_bf_find_n(.25, .5, InvAltPrior, 54, function(bf){bf>5}, 1000, 50, 300, .8)
# [1] 74
binwalk_bf_find_n <- function(orig_se, meandiff, altprior, orig_n, bayestest, reps, min_n,
max_n, req_prob) {
  if (min_n + 1 >= max_n) {
    return(max_n)
  }
  mid_n <- round(mean(c(min_n, max_n)), 0)
  prob_mid <- sim_bf_prob(orig_se, meandiff, altprior, orig_n, mid_n, bayestest, reps)
  if (prob_mid > req_prob) {
    return(binwalk_bf_find_n(orig_se, meandiff, altprior, orig_n, bayestest, reps, min_n,
mid_n, req_prob))
  }
  return(binwalk_bf_find_n(orig_se, meandiff, altprior, orig_n, bayestest, reps, mid_n,
max_n, req_prob))
}
```

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