

# RETRO-ACTIVE TRAINING OF RATIONAL VS. INTUITIVE THINKERS

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## Abstract

Retroactive effects were investigated in the context of a Master thesis on the effect of instruction on intuitive and rational thinkers in a Go-NoGo task. During the first phase of the task subjects were instructed to respond to two randomly chosen symbols and to ignore two other symbols. In the second phase of the task half of the subjects got the instruction to respond as quickly as possible (speed-instruction) while the other half got an instruction to avoid errors (accuracy-instruction). Major research questions of the project dealt with the effect of both instructions on task performance and the interaction of the type of instruction with the type of processing style (intuitive vs. rational). Results concerning these main stream research questions have been reported elsewhere (Bijl, 2012).

In the second phase of the Go-NoGo task only one symbol was to be responded on. This symbol was randomly chosen from the two that were used as stop-signals in the first phase. In accordance with the growing literature on retroactive influences on cognition and emotions, where future events seem to have an anomalous, retroactive influence on responses and behavior in the present, we predicted that the second task would have a practice effect on performance during the first task.

This prediction was confirmed. During the first session, the subjects responded significantly faster to the symbol they also had to react to in the second session, than to the symbol they only had to react to during the first session ( $p=0.038$ ). The subjects with an intuitive thinking style were totally responsible for the whole effect. (intuitives alone:  $p < 0.001$ )

## 1. Introduction

### 1.1 Retroactive influences

Lately there have been multiple studies on retroactive influences on cognition, where future events seem to have an anomalous, retroactive influence on responses made in the present. One example of this, which has received quite some attention in the last decades, is presentiment: Multiple studies have shown that certain measures of arousal (galvanic skin response for instance) can show an increase a short time before the actual onset of an arousing stimulus (e.g. Bierman & Radin, 1997; Bierman & Scholte, 2002). Such results suggest that information concerning a stimulus can actually go back in time (from milliseconds to seconds). Another example of the same phenomena is retroactive priming, where primes shown after the target stimulus, have an effect on the response latency for that stimulus (e.g. de Boer & Bierman, 2006; Bem, 2011).

Another example of this phenomena, but showing said anomalous retroactive effects even earlier (multiple minutes back in time), is retroactive practice or learning (e.g. Franklin & Schooler, 2011a; 2011b). Simply put, it is conventional practice turned around. Studying for an exam is a good example: Normally, studying before an exam influences one's performance during that subsequent exam. According to the theory of retroactive influences, it is theoretically possible to influence one's performance on an exam by studying for it after it has taken place. A notion worth investigating of course (but difficult to get consent for)!

Some of the abovementioned studies will now be described in more detail. Bem (2011) did a study, consisting of nine separate experiments, on precognition and premonition, two examples of a more general phenomenon: A retroactive, anomalous influence of a future event on a person's current responses. All but one of these experiments yielded significant results, supporting these retroactive effects. One of these experiments for example was a reversed priming experiment: Participants judged pictures as being pleasant or unpleasant. After being shown a picture, instead of before like in a regular priming experiment, a congruent or incongruent word would quickly be shown. Participant responded significantly faster on congruent trials than on incongruent trials.

It should be mentioned that this study has attracted strong criticism. A good example of such criticism is from Wagenmakers et al. (2011), who call upon Bayesian statistics in an attempt to weaken Bem's results. The points they and others have raised are either incorrect or applicable to statistics in experimental psychology in general.

In studies such as mentioned above, where anomalous retroactive influences are tested, it is essential that the future condition that is supposed to 'influence the past', is chosen randomly. If that condition is not met, then normal inferential processes about the future might have caused the current performance in the present. In studies such as mentioned above (and in the current experiment as well), the selection of the future condition is general based upon the outcome of an electronic or software-based random number generator. Franklin & Schooler (2011a; 2011b) however conducted multiple experiments (yet to be published) where they used the abovementioned retroactive practice effect to predict real world events (in this case: the spin of a roulette wheel). To do this they used a setup quite similar to the one used in the current experiment: During two subsequent Go/NoGo sessions, one of four predetermined shapes randomly appeared on a screen for multiple trials. During the first session subjects have to react to two of the four shapes. During the second session, subjects now only have to react to one of these two shapes. Which of these two shapes they have to react to during the second session is determined by the spin of a roulette wheel: If the outcome is red they choose one figure, if the outcome is black they use the other figure. This allows for a comparison of the two shapes during the first session; If their response during the first session is quicker for the matching shape (that they also have to respond to during the second session) than for the other shape, retroactive practice would appear to have taken place. **Their results were a bit less straight forward than a superior performance in the first session for the shape exercised in the second session. However the roulette determined condition in session 2 correlated with performance in session 1 and, on the basis of this retrocausal correlation, they** developed an algorithm which analyses subjects' performance on both Go-shapes during the first session, to determine which of the two shapes they will have to react to during the second session before this choice takes place, thereby predicting the outcome of the roulette

wheel-spin. During these experiments they achieved success rates between 57 and 60 percent in predicting these outcomes!

The Consciousness Induced Restoration of Time Symmetry model (Bierman, 2010) is based upon the fact that in physics time-symmetry is a part of most formalisms. Apparently this symmetry has been broken for most physical systems. It is assumed that under specific information processing conditions this symmetry is partly restored. In that case one would expect correlations that appear to be retrocausal. The particular context that restores the symmetry is that information is processed by an extremely coherent multi-particle system like our brains. This introduces also the single parameter that can account for individual differences, namely the coherence of the brain. It can be argued that intuitive participants have a more global and spontaneous type of information processing than more rationalistic (serial thinking) participants.

Since the setup of this current study is quite comparable to the setup used by Franklin & Schooler (2011a; 2011b), we decided to test said anomalous retroactive practice effects, in addition to its original purpose (see Bijl, 2012).

The setup of this experiment was as follows: During the first phase of the task subjects were instructed to respond to two randomly chosen symbols and to ignore two other symbols. In the second phase of the task half of the subjects got the instruction to respond as quickly as possible (speed-instruction) while the other half got an instruction to avoid errors (accuracy-instruction). During this second phase of the Go-NoGo task only one symbol was to be responded to. This symbol was randomly chosen from the two symbols that the subjects had to react to during the first phase.

## 1.2 Hypotheses

We hypothesize that practice in the future can affect performance in the present (psi-hypothesis). Since these phenomena occur nonconsciously, we also suspect that intuitive thinkers are more prone to be affected by retroactive practice effects.

## 1.3 Predictions

- I. The second Go/NoGo session will have a training effect on performance during the first Go/NoGo session. We predict that subjects (for example: when using figure A, B, C & D) who have to respond to figure A during the second session will perform better on figure A than on figure B during the first session (and vice-versa for subjects who have to respond to figure B in the second session).
- II. We also predict that this effect will be more pronounced for subjects with an intuitive thinking style.

## 2. Method

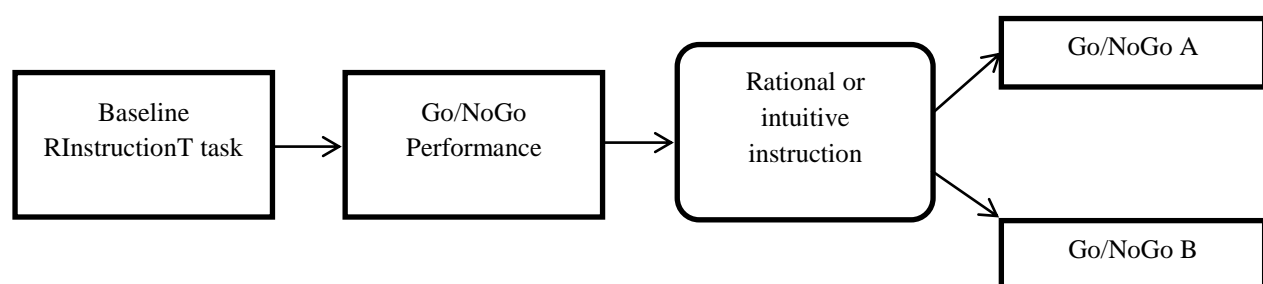
### 2.1 Subjects

In total, 69 people (35 female; 34 male), with a mean age of 20,81, completed the experiment. The subject pool consisted of some first-year psychology students participating for credits as a mandatory part of the curriculum at the University of Amsterdam and for the most part of exam-year students from a local high-school in Alkmaar. This was due to a low availability of participants at the university. This however had the added benefit of minimizing the effect of using psychology students as subjects on the data, resulting from their knowledge of psychological testing, and error variance in general.

### 2.2 Procedure & Materials

After arriving at the facility subjects were asked to read an information brochure informing them about the nature of the experiment. Here they were introduced to the shapes that were used during the two Go/NoGo sessions (see figure ) and informed that they were free to quit the experiment at any time. Subjects then were asked to read and sign an informed consent form and subsequently asked to take place behind a computer for the experiment.

During the initial baseline reaction time task, subjects had to respond to an “X” appearing center screen on a computer at random intervals, ranging from 1000 to 3000 milliseconds, during 20 trials by pressing the enter button on the keyboard, to establish a baseline reaction time measurement.



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After this subjects were given the first Go/NoGo task, with the instruction to simply do the best they can. The task was made up as follows (see figure 2): Subjects were, during 64 trials, randomly shown one of four predetermined shapes on a computer screen at random intervals ranging from 1500 to 3500 milliseconds, with a timeout limit of 2000 milliseconds (if subjects didn't (have to) respond). The screen size of the shapes was 3,5 cm by 3,5 cm. They were asked to respond (press the enter button on a keyboard) to two of these shapes (e.g. shape A and B) and not respond to the others (e.g. shape C and D). After this they entered a second Go/NoGo-phase, where they were asked to respond to only one of the two shapes they had to respond to during the initial Go/NoGo task (ergo: in this example: shape A

or B). Which of the two shapes they had to respond to in this second session was randomly assigned per subject using a software-based random number generator. For the sake of the psi-hypothesis, the shape subjects had to respond to on both sessions will be referred to as the target-shape.

The shape subjects only have to respond to during the first session will be referred to as the control-shape. Prior to the second session they were given one of two instructions:

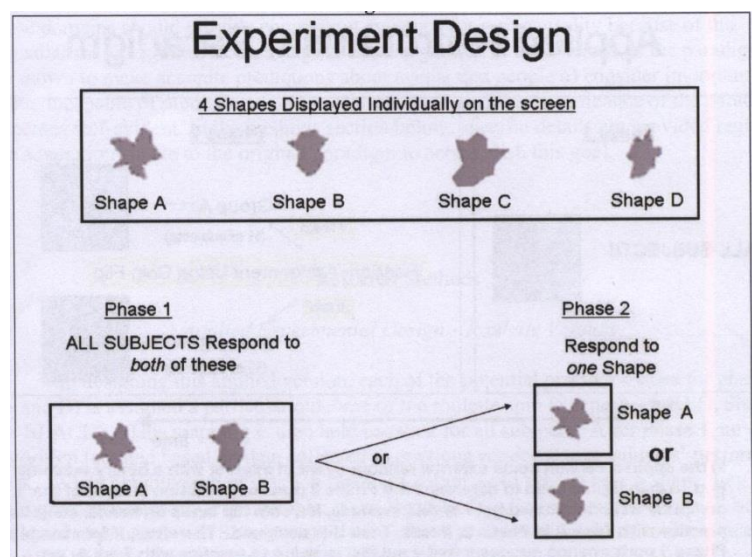


Figure 2: Experiment design

They were either asked to respond as fast as they can (intuitive instruction) or to respond as accurately as they can (rational instruction).

During this task the program tested whether subjects were actually following the instructions they were given. In case of the intuitive (speed) instruction, the program instructed subjects to respond faster when their reaction time fell too far below their mean reaction time measured during the initial reaction-time task. The limit was set at 125% of their mean reaction time during the initial reaction time-task. In case of the rational (accuracy) instruction, the program instructed subjects to be more careful and reflect on their responses better when they made an error. The program used during the experiment (with the

abovementioned setup) was written with 'Visual Basic' programming language, using 'Real Studio 2011', version 4.3.

Finally, using the H.I.P.-questionnaire (Human Information Processing, Taggart & Valenzi, 1990), subjects' tendency towards rational or intuitive reasoning was assessed. This was done after the actual Go/NoGo tasks to avoid an effect of this questionnaire (and the resulting reflection on one's thinking style) on subjects' natural style and resulting performance. The Taggart-Valenzi human information processing (HIP) survey (1990) assesses thinking style in rational-intuitive terms by scoring an individual on six different scales: Analysis, planning and control (which are positively correlated to a rational style) and insight, vision and sharing (which are positively correlated to an intuitive style) (Taggart & Valenzi, 1990). Subjects are given statements concerning their thinking style of which they have to rate on a 6-point scale how much the statement applies to them, from 'always' to 'never'. An example of such a statement is "When working on a task, I prefer working alone over working with a group."



### 3. Results

#### 3.1 Variables

Of the 69 people that completed the experiment, one had to be excluded from the analyses, because of a computer error during the H.I.P.-questionnaire, resulting in data loss.

From that data mean reaction times were calculated from the reaction time task for each subject. In addition, mean reaction times were calculated for each Go-shape during the two Go/NoGo tasks per subject (two during the first and one during the second session). We normalized these reaction times, by dividing a subjects' reaction time on a Go-shape, by their mean baseline reaction time measurement. Error rates were also calculated per session per subject.

For the H.I.P. scores, the three scores related to a rational thinking style were added per subject. The same was done for the three scores related to an intuitive style, resulting in two scores for each subject: One signifying the amount of rational thinking (rational score) and one the amount of intuitive thinking (intuitive score). The intuitive scores were subsequently divided by the rational scores, resulting in a thinking style-score, roughly varying between 0,75 and 1,5, the first indicating a very intuitive thinking style, the latter a very rational one.

#### 3.2 Manipulation checks

To check whether the four shapes used in the Go/NoGo tasks were actually equally difficult to remember and respond to, one-way ANOVA's were performed with the normalized reaction times and error rates as the dependent variables and the target and control-shapes as between-subject factors. For the reaction times, none revealed a significant difference between the shapes. For the error rates, during the first Go/NoGo session, the control-shape error rates did differ significantly from one another ( $F_{(3, 68)}=3,855$ ,  $p=.013$ ). The target-shape error rates didn't differ significantly during the first session. During the second session however, the target-shape error rates were significantly different from one another ( $F_{(3, 68)}=2,792$ ,  $p=.047$ ).

There was no consistency however in which of the four shapes produced more or less errors during the two sessions, suggesting a random effect.

To check whether the instructions given before the second Go/NoGo session, and reinforced by the computer during the second session, actually had the desired effect, one-way ANOVA's were performed with instruction condition as between-subject variables, comparing the error rates and normalized reaction times of subjects with a speed instruction with subjects with a accuracy instruction. This was done both for the whole subject pool, and the subjects with instructions congruent to their styles of thinking separately. None of the analyses revealed a significant difference. Although subjects with an accuracy instruction did consistently make less errors than subjects with a speed instruction, this difference failed to reach true significance ( $p=0.1$ ). The same analyses were also performed for rational and intuitive thinkers separately. These also showed no significant difference in normalized reaction times and error rates.

Analyses revealed no extreme outliers amongst the reaction times, error rates and thinking style scores, except for one subject who had an extremely high error rate. This subject was also excluded, resulting in a total of 67 subjects used in the analyses.

To check a potential fundamental difference in response times of intuitive and rational thinkers, one-way ANOVA's were performed with thinking style as a between-subject factor, comparing both the absolute and normalized reaction times of intuitive and rational thinkers for both Go/NoGo sessions. In the same manner we also compared the baseline reaction times of intuitive and rational thinkers. Subjects were divided into two groups (a rational and an intuitive group) based on their thinking style-score, using the subject pools' mean of this variable as the dividing point. The baseline reaction times showed no significant difference between intuitive and rational thinkers. Although the intuitive thinkers consistently reacted quicker to the target-shape than the rational thinkers during the first Go/NoGo session, this difference also failed to reach significance. The control-shape showed no difference between rational and intuitive thinkers. When the absolute H.I.P. scores were used as a between-subject factor however, the normalized control-shape reaction times did show a marginally significant difference ( $F_{55, 66} = 2,438, p = .054$ ). During the second Go/NoGo

session, the target shape also showed no significant difference in absolute and normalized reaction times between rational and intuitive thinkers.

### 3.3 Testing the hypotheses

1. To test our (psi) prediction, that the second Go/NoGo session will have a training effect on performance during the first Go/NoGo session, the reaction times to both Go-shapes during the first session (the target - and control-shape) were compared to each other, to inspect whether the second session had a retroactive practice effect on the first session. A paired samples T-test was performed, comparing the normalized reaction times to the control - and target-shape during the first Go/NoGo session. The reaction times to the target-shape proved significantly lower than the reaction times to the control-shape ( $t = -2,114$ ,  $df = 67$ ,  $p = .038$  two-tailed), suggesting a retroactive practice effect of the second session on the first (see table 1).

**Table 1: Baseline reaction times and normalized reaction times of rational and intuitive thinkers for both Go/NoGo sessions**

	Baseline RT Session			1st Go/NoGo Session					
				Target symbol			Control symbol		
	Mean	N	Std. Dev.	Mean	N	Std. Dev.	Mean	N	Std. Dev.
Intuitive thinkers	354,46	35	31,98	1,73	35	0,23	1,80	35	0,25
Rational thinkers	353,35	32	29,25	1,79	32	0,2	1,79	32	0,22

	2nd Go/NoGo Session					
	Target symbol					
	Speed instruction			Accuracy instruction		
	Mean	N	Std. Dev.	Mean	N	Std. Dev.
Intuitive thinkers	1,64	17	0,24	1,65	18	0,24
Rational thinkers	1,77	15	0,23	1,66	17	0,18

2. To test whether this effect was more pronounced for subjects with an intuitive thinking style, the same paired samples T-tests were performed for intuitive and rational thinkers separately. Now, only the intuitive group showed a significant difference ( $t = -3,412$ ,  $df = 34$ ,  $p = .002$ ). A one-way ANOVA with thinking style as a between-subject factor was also performed, comparing the difference in normalized

reaction times between the target - and control-shape during the first Go/NoGo session for rational and intuitive thinkers. Again, the difference in reaction time proved significantly greater for intuitive thinkers than for rational thinkers ( $F_{(1, 67)} = 4,477$ ,  $p = .038$ ), with an effect size  $r$  of 0.25 (Cohen's  $d = 0.52$ ).

#### 4. Discussion

The prediction that the second Go/NoGo session would have a training effect on performance during the first Go/NoGo session and that this effect would be more pronounced for subjects with an intuitive thinking style, was supported by the results. During the first Go/NoGo session, intuitive subjects reacted significantly faster to the shape that they also had to react to during the second session than to the shape they only had to react to during the first session. Rational subjects did not show this difference at all. This suggests that, for the subjects with an intuitive thinking style, the second session had a retroactive practice effect on subjects' performance during the first session. When this difference was compared for the entire subject pool, it was still significant, with an effect size  $r$  of 0.25, which is comparable to what Franklin & Schooler (2011a; 2011b) found in their experiments.

The only feasible alternative explanation for this, that the shapes used in this experiment weren't equally difficult to remember and respond to, was refuted by the results of the manipulation check: although the shapes showed a significant difference in error rates in some cases, this difference appeared to be random in nature; there was no consistency over which shape caused more errors than others amongst the analyses. Of more importance for this hypothesis, was that none of the shapes showed a significant difference in reaction time for both Go/NoGo sessions. We further checked the relative frequencies of the different symbols and combinations of symbols (table 2).

Table 2: frequencies of the different symbols and their combinations in the target and control role.

**Target symbol \* Control symbol Crosstabulation**

Count		Control symbol				Total
		1	2	3	4	
Target symbol	1	0	7	5	4	16
	2	6	0	5	4	15
	3	9	6	0	4	19
	4	7	6	5	0	18
Total		22	19	15	12	68

It can be seen that the target symbols are equally distributed. The *control* symbol distribution is skewed where symbol 1 is overrepresented at the cost of symbol 4. If symbol 4 would have been easier than symbol 1 this could have explained the results but the raw results show that the mean response time to symbol 1 is The fact that the difference in reaction times between the control - and target-shapes was only found for intuitive thinkers, further refutes this alternative explanation based upon different difficulties and different frequencies..

As counterintuitive and controversial as these results may seem, they are not the first of its kind. As mentioned in the introduction, Bem (2011) also found evidence of future events influencing a subjects' current responses. It is also important to remember in this respect, that in the field of physics and quantum mechanics especially, the notion of backward time effects is already accepted (e.g. Atkinson, 2000) . Antimatter for example, can be described as matter traveling backwards in time (e.g. Feynman, 1962).

To begin to formulate an explanation of the workings of retroactive practice and similar phenomena, is still a very hard, if not impossible task. The abovementioned antimatter could for instance play a role in it, but this is pure theorizing. In a rather recent theoretical framework CIRTS (Consciousness Induced restoration of Time-Symmetry, Bierman, 2010) it is proposed that information processing in an extremely coherent system like our brains when supporting consciousness, time-symmetry which is fundamental in almost all physical formalism, is retroed due to specific boundary conditions that otherwise hardly exist in Nature. More breakthroughs in both fields, physics and psychology, are needed before we can begin to truly test and comprehend the workings behind these anomalous findings.

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