Money makes the world go round: An integrative approach towards the effects of reward on the effort-liking relation

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Abstract

Money is one of the most influential factors on modern day society. Money also influences behavior on individual level; it ensures we work hard because effort is increased when monetary rewards are at stake. Normally effort serves as signal for intrinsic motivation, which in turn influences liking. According to results from scientific research, the intrinsic motivation will often start declining when external rewards are at stake. This phenomenon, called the overjustification effect, shows that people tend to make behavioral attributions to determine why they performed an activity. This study examined, for the first time, this phenomenon in a single design using three measures; effort, liking and the relation between these two. Pupil dilation, recorded with a Tobii eye tracker, was used as a measure of effort. The results show no significant increase of effort when monetary rewards are at stake but effort does decrease significantly when this reward is taken away. Measuring effort with the use of pupil dilation seems to be a valid, reliable measure in this experiment. Hypothesis two which states that effort increases liking is not confirmed, so exerting more effort does not make people like the task more. Furthermore, there is no significant evidence found to support the hypothesis that monetary rewards decrease liking of the task.

Introduction

Money, who doesn't love it? It is one of the most wanted things in modern day society and people will sometimes do the most irrational, immoral and bizarre things to obtain it. The four most common emotional associations with money are security, power, love and freedom (Furnham, Wilson, & Telford, 2012). Money also ascertains we work hard since people tend to increase effort when monetary rewards are at stake. Rewards encourage people to perform better on physical and cognitive tasks (Zedelius, Veling, & Aarts, 2011). However, imagine you are a volunteer at an organization for homeless animals; you like what you do and you do not care about not getting paid. The reason getting paid is not of any concern to the volunteer could, according to research (Aronson & Mills, 1959), be that when you put effort into something, you like what you do more. The intrinsic motivation is in this case high. To be intrinsically motivated, is to perform an activity that provides no apparent reward except for the activity itself (White, 1959). What would happen when you start paying a volunteer? The volunteer will probably increase effort when money is at stake, but effort will decrease below baseline when external rewards are taken away (Zedelius, Veling, & Aarts, 2011). According to results from scientific research, the intrinsic motivation will probably start declining when external rewards are at stake. This phenomenon, called the overjustification effect, shows that people tend to make behavioral attributions to determine why they performed an activity. When external rewards are provided, people will attribute their behavior to the reward instead of the intrinsic motivation.

This overjustification effect does not seem logical, since research (Zedelius, Veling, & Aarts, 2011) suggests that people exert more effort on a task when monetary rewards are provided. When you look at classical reward research (Deci, 1971) effort and liking seem dissociated. On the other hand there is also research indicating that effort would increase task liking (Cardozo, 1965). So, it is hard to say what is going on exactly also because the used research measures are not the best suited to examine the underlying processes. To discover the secret behind the overjustification effect, this study is designed to investigate how monetary rewards impact effort, task liking, and their relation. By using a physiological approach, and by measuring all the variables in one design, it is expected that a clearer view on the mechanisms will be obtained. So what the real question is: when money comes in the game, do other things still matter? Or are we all just in it for the money?

The effort-liking link

Humans use the amount of perceived effort as a signal of motivation. By observing others, people can infer their goals (Aarts, Gollwitzer, & Hassin, 2004). It has also been shown that observing an animation of a ball pursuing a goal activates spontaneous goal inference. The amount of perceived effort of the ball to reach the goal has a positive correlation with spontaneous goal inference; the more perceived effort, the easier the goal is inferred by people (Dik & Aarts, 2007). The same results were obtained by three experiments conducted by Kruger and colleagues (2004). In all three experiments participants were asked to assess the quality and the value of the product and how much they liked it. In these experiments they either had to assess a poem, a painting or a suit of armor. All participants rated the same products and the manipulated factor was the effort that participants were believed was put into the products. The more perceived effort was put into the products, the higher the assessment of quality, value and liking. However, an important factor was the ambiguousness of the product. With a more ambiguous product, effort has a bigger impact on the assessment.

Next to the influence of perceived effort of others on evaluation, the effort of people themselves also serves as an indicator of quality. In general the harder people have worked on or for something, the more it is liked by them when they have to evaluate. This phenomenon is observed in a variety of studies. When for example people are put through an unpleasant initiation to become a member of a group, they will like the group more than when they become part of that group without having to go through this process (Aronson & Mills, 1959; Gerrard & Mathewson, 1966). Customer satisfaction with a product is also influenced by the amount of effort they have to go through to acquire it. Thus, more effort leads to higher satisfaction with the product (Cardozo, 1965). In a study by Brown & Peterson (1994) on the effects of job performance and work related effort on job satisfaction, it was found that work related effort had a direct positive effect on job satisfaction which was not mediated by job performance. Naturally if people like a certain activity, they are more willing to work harder, making this relation bidirectional. More recent work found that the weight of a clipboard where participants were working on influenced them to give bigger weight to the importance of that work (Jostmann, Lakens & Schubert, 2009). This shows that the invested physical effort on dealing with objects influences the cognitive evaluation. Vice versa, it has been shown that the perceived importance of work influences the perception of weight (Schneider, Rutjens & Jostmann, & Lakens, 2011). When participants in this study believed that a book was important they perceived the book as heavier than an unimportant book. So, again it seems there is a bidirectional positive relation between evaluation and effort.

This bidirectional relation can be explained by the cognitive dissonance theory, first postulated by Festinger (1957). This theory proposes that when certain cognitions, beliefs or behaviors of an individual are not in line with each other, the person will experience cognitive dissonance. Since people experience dissonance as aversive they are motivated to resolve it (Elliot & Devine, 1994). Resolving cognitive dissonance is the underlying factor why people evaluate certain unpleasant activities as more pleasurable after they have invested effort into it (Festinger & Carlsmith, 1959; Harmon-Jones, Amodio & Harmon-Jones, 2009).

The money-effort link

People tend to increase effort when monetary rewards are at stake. It seems that rewards encourage people to perform better on physical and cognitive tasks. Rewards influence the way we maintain and act on information relevant to attain our goals, providing successful goal-directed behavior (Zedelius, Veling, & Aarts, 2011). People thus have the tendency to adapt their effort on the magnitude of the reward as a motivational process (Pessiglione et al., 2007). According to Salmone (1988) dopamine activity in the nucleus accumbens is also critically involved in activational aspects of motivation and thus is correlated with effort in instrumental tasks. The increased effort is often translated in greater speed or accuracy or a trade-off between both. Research of Toppen (1965) found that people show greater performance in response to greater magnitude of reward. This has also been found in animal research; it seems that people respond to monetary rewards as animals respond to other types of rewards. In addition, Siegel (1961) showed that monetary rewards lead to more accurate performance of a monotonous predicting task.

The money-liking link

External rewards are not always necessary to motivate people. Some tasks provide people with an inherent reward. When you give people external rewards for an intrinsically interesting activity, it seems that the external reward decreases the interest and engagement in the activity (Pretty & Seligman, 1984). Among others, Deci (1971) showed that tangible rewards could decrease intrinsic motivation for an intrinsically interesting activity. This phenomenon is also called the overjustification effect. People tend to make behavioral attributions as to why they performed an activity. When people are given a reward for an activity they will attribute their behavior to the reward instead of their intrinsic motivation.

The cognitive evaluation theory (CET) also tries to explain this overjustification effect. Intrinsic motivation consists of the psychological needs for autonomy and competence. So it depends on the person if a reward is seen as a controller of behavior or as an affirmation of competence (Deci, Koestner, & Ryan, 1999). Gneezy and Rustichini (1998) also found the overjustification effect when they had people perform a few simple tasks, like collecting donations. If participants were paid a small amount of money they performed worse than those who did not get anything. Performance was measured with the amount of tasks the participants performed when they were told they had to perform as many as they could. The money decreased the amount of tasks the participants performed, which was used as an indicator of liking. Quoidbach, Dunn, Petrides, and Mikolajczak (2010) even found that priming random people with money, wealthy or not, makes people like things less. It appeared that participants who were primed with money were less likely to savor a piece of chocolate afterwards. The savoring ability is an ability that enhances and prolongs positive emotional experience. The time to eat the piece of chocolate was used as a measure of savoring and thus liking.

Deci (1971) investigated the effects of externally mediated rewards on intrinsic motivation. In his experiment participants were asked to come to the lab three times on different days. During the three blocks of the experiment, the subjects were engaged primarily in working on a puzzle called Soma, which is proposed to be an intrinsically motivating task for students. After this, participants were asked to reproduce four configurations that had been drawn on paper using the puzzle pieces. The time it took for participants to complete each configuration was measured. The reward and the no-reward (control) group got the same tasks. In the first block, both the reward and the control group did not get paid for the task (figure 1). In the second block, participants in the reward group got paid one dollar per correct configuration, but the control group did not get paid, see block two in figure 1. During the third block neither the reward nor the control group got paid (figure 1). To measure motivation, the experimenter left the room in the middle of each session. Subsequently, motivation was measured in form of the amount of time the participant spent working on the puzzle during the period the experimenter went away. The experimenter observed and timed the participants trough a one-way window. This way Deci (1971) found that external rewards decrease the intrinsic motivation for that activity.

Since motivation was measured through observance of an experimenter, it can be said that this measure is not really objective. And over the years there is been quit some critic on the work of Deci regarding the experimental procedures (see Mawhwinney, 1979 and Bernstein, 1990 for an overview). Despite long-lasting critiques, a meta-analytic review by Deci, Ryan & Koestner (1999) showed that the effects of reward on liking are reliably found.

Figure 1: Reward and control group per block, divided in six conditions.

	Block 1	Block 2	Block 3
Reward group	R1: No reward	R2: Reward	R3: Reward withdrawn
Control group	C1: No reward	C2: No reward	C3: No reward

An integrative relation between reward, effort and liking

The results obtained from the fields of the links reward-liking and effort-liking seem contradictory. Since more effort results in more liking and rewards lead to more effort, on first sight it seems logical to assume that rewards enhance liking. This relation however is not found by scientific experiments. A possible explanation for this discrepancy could be that when rewards are responsible for enhanced effort they obscure the link between effort and liking. This probably happens because the amount of effort expended is attributed to the reward and for this reason no longer serves as indicator for liking. Earlier research like that of Deci (1971) does not allow for strong conclusions to be made about the effects of rewards on liking because of the vagueness of their procedures. The present study wants to implement well-controlled conditions and procedures in order to give more insights in the effects of reward on liking. On top of that this study will, for the first time, combine measurements of expended effort with the effects of reward on liking. This way, the relation between the three factors (reward, effort and liking) can be investigated in one paradigm. In order to implement these three factors in one paradigm, an objective measure of effort is needed.

Measuring effort

The effort people invest on a task is highly correlated with sympathetic activity. When people have to invest more effort on a mental task, measurements of sympathetic activity increase. These results can be reliably found for heart rate, skin conductance and pupil dilation (Kahneman et al., 1969). These increases were found during intake and processing of information and decreased during the report phase when less mental effort was needed. When tasks become increasingly difficult the sympathetic activity increases accordingly because more mental effort is needed to carry out the task in a proper way (Kahneman et al., 1969; Iani et al., 2004; Veltman & Guillard, 2010). Next to the influence of task difficulty on sympathetic activity, the deliberate mental effort that people devote to a task also increases sympathetic activity independent of task difficulty (Iani et al., 2004). The deliberate effort put into a task by participants can be manipulated by means of instructions (Wickens, 1984).

In this study pupil dilation will be used because it is a fast and reliable measure of mental effort. The onset of this response lies between 100 ms to 200 ms and terminates as rapidly when the processing of the tasks is completed (Beaty, 1982). Since pupil dilation cannot be voluntary controlled, it is provoked by external stimuli or mental events, it is an exceptional objective measure of sympathetic response (Laeng, Sirois & Gredebäck, 2012). Three responses of task-evoked pupil dilation can be distinguished which are all related to effort. These responses are the mean pupil dilation, peak dilation and latency to the peak (Beaty & Lucero-Wagner, 2000). In a study by Van Gerven and colleagues (2002) all these responses were investigated under different levels of cognitive load in both young and old participants. All showed to be a reliable measure. The key brain structure responsible for pupil dilations evoked by psychologically relevant stimuli is the locus coeruleus (Wilhelm, Wilhelm, & Lüdtke, 1999). This structure plays a vital role in attentional processes and pupil dilations are there fore a good measure for effortful engagement (Laeng, Sirois & Gredebäck, 2012).

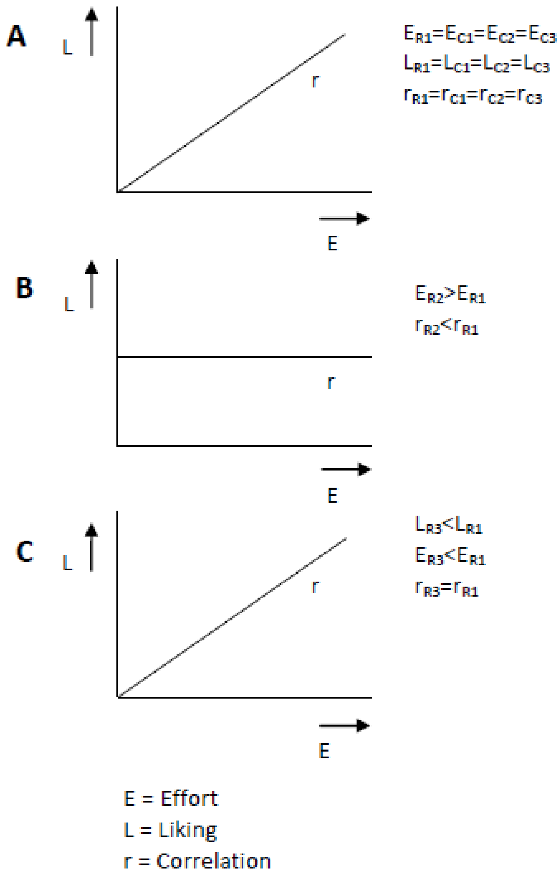


Figure 2: Schematic overview of the hypotheses

Experiment and hypotheses

This study has for the first time incorporated measures of effort and liking in one paradigm and investigated how rewards act on these measures. This integrative research made use of the same design as Deci (Figure 1). In this experiment however all blocks consisted of the same procedure and participants performed visual search tasks. Like in the Deci design there were three blocks. In the reward group participants performed block R1 without getting rewards. In R2 the first manipulation was implemented and participants received rewards for performing the tasks. In block R3 these rewards were withdrawn. In the no-reward group all three blocks (C1, C2 and C3) were the same as block one for the reward condition. In all blocks participants evaluated how much they liked the tasks after each trial and measurements of effort were obtained while performing the tasks by measuring pupil dilation.

The first hypothesis is that the invested effort in block R2 will be higher than average and that the invested effort in block R3 on the other hand will be lower (figure 2C) as is shown by earlier research (Deci & Koestner, 1999).

As shown by Deci (1971) rewards lead to a lower intrinsic liking of activity, and after the reward block participants are less intrinsically motivated to be involved in the task. This leads to the second hypothesis that in block R3 the task evaluation will be lower (figure 2C).

Since the evaluation of liking correlates with effort in earlier research, it is expected that in the no-manipulation blocks (R1, four C1, C2 and C3) a correlation between effort and liking will be found, and that scores of liking and effort will be similar between these blocks (figure 2A). So, the third hypothesis is that there is a correlation between effort and liking, but that this correlation will be disrupted due to rewards in block R2 and R3.

Methods

Participants and design

54 subjects were tested in total. After data reduction (see *'Data reduction & analysis')* the results of 34 subjects were decided to be usable for statistical testing. The 34 participants (mean age =22.6, SD=3.4) consisted of 17 men (mean age =23.4, SD=4.3) and 17 women (mean age =21.8, SD=2.1). All subjects completed three blocks, each block consisting of ten trials. The study is a 2 (reward: money vs. nothing, between subjects) x 3 (block, within subjects) design. A total of 16 subjects were in the reward group (mean age =22.4, SD=2.4) and 14 were in the control group (mean age =22.8, SD=4.1). All subjects got paid a set amount of money for their time (4 euro). In addition, the subjects that were part of the reward group got rewarded with 40 eurocents for every trial in the second block (R2) of the experiment. This way they could double the initial amount earned for participating. In the control group participants did not receive any extra rewards.

Task

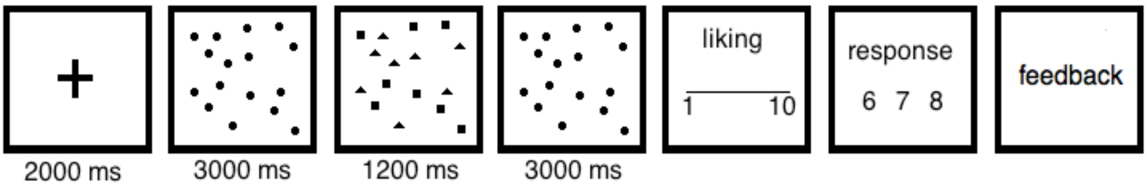
A visual search task is used to test our hypotheses. Participants have to decide how much targets there are among the distracters, both are displayed on a random position on the screen. There are 30 slightly different trials, each participant performed all trials once and trials were presented randomly. The trials differ in color (six colors) and the locations of the stimuli. The targets were identical in all trials and each trial was presented once. This way the instructions stayed the same (how many blue triangles do you see among the distracters). These differences in color are important since this makes the task more enjoyable, so this influences task-liking.

Each trial started with a fixation cross shown for 2000 milliseconds, and then sixteen randomly located dots appeared on screen, shown for 3000 milliseconds. These dots then changed into eight triangles and the remaining dots transformed into distracters for 1200 milliseconds, before they changed back to dots (3000 milliseconds). Pilot studies have indicated that the 1200 milliseconds to determine the number of targets is not sufficient to respond correctly for most people. After the visual search task, a visual analog rating scale appeared where participants rated their liking of the trial. Then, the participants are asked to click on the number of targets they saw in the trial. The number of targets stayed the same throughout the experiment; there were 8 targets in every trial. After clicking on the number of targets, participants get feedback if their answer was right or wrong. The given feedback was random with a 7/8 chance on positive feedback and 1/8 chance on negative feedback per trial.

Feedback on the amount of effort was given too, this also was random with the same chances as the right/wrong-feedback. A schematic outlay of a trial is shown in figure 3. All responses have been done with a mouse so the participants did not have to look down at the keyboard as this might influence the measurements taken with the eye tracker. This was repeated ten times per block.

The order of first having to rate the liking of the trial and then having to give the correct response is chosen because the aim of the experiment is to research liking and effort, a correct response is less important in this study.

Figure 3. Schematic outlay of a trial



Technique

Eye movements were recorded with a Tobii-X120 binocular infrared eye tracker (sampling at 120 Hz, 0.5° accuracy; Tobii Technology, Danderyd, Sweden).

Procedure

Participants worked in individual sessions on a computer with the Tobii X120 eye tracker attached underneath the screen. They performed the task in a soundproof enclosed chamber with all light coming from one light source.

At the start instructions were shown on the monitor, followed by a fixation cross, after which the visual search task began (figure 3).

The reward group got paid on performance in the trials in the second block. Participants were believed that they earned more money for their effort. In reality the reward was randomly given or withheld from the participants. They had a chance of 7/8 times to receive a reward (40 cents per trial) and 1/8 chance not to receive a reward. They did not get rewarded for the first nor third block, this was explained before block two (R2) and three (R3) commenced by the instructions on screen.

Data reduction & analysis

The statistical program R Studio (R Development Core Team, 2012) was used to edit and reduce data recorded with the Tobii eyetracker.

Trials with less than 30 raw data points in the baseline or less than 60 raw data points in the task period were excluded from the raw pupil dataset. Then the dataset was controlled for measurement errors by excluding data points with pupil values of less than two millimeters. The start- and endpoint of each trial was identified to isolate every trial, after which the practice trials were removed from the dataset.

The pupil dilation baseline is determined for each participant. This was measured during the 2000 milliseconds the fixation cross was shown on screen (figure 3). Pupil dilation peaks were measured by subtracting this baseline measure of the maximum values for pupil dilation during each trial. The pupil dilation peaks were measured over 7200 ms, the duration of the task (figure 3). For every trial the baseline and maximum pupil dilation was measured. Subtracting the baseline off the maximum pupil dilation leaves the pupilscore, which we used for further analysis. Only participants where at least five pupilscores per block could be measured were used to do the statistical analysis.

The subject number, trial type (reward vs. control group) and the answer to the liking-question are then identified. This information was used to compute the mean of liking for every block for every participant, pupil dilation (effort) and the relation between liking and pupil dilation for every block for every participant.

The pupil dilation peak for each trial was plotted on the y-axis of a scale. This gives a measure of effort for each trial. The liking of each trial was plotted on the x-axis of the scale. In this way every trial produces a measuring point on the effort-liking scale. The 10 trials in each block resulted in 10 points and the correlation between effort and liking was calculated for each participant in every block.

The results of all participants in one group were averaged per block for effort and liking. These averages were used to do the statistical analyses in SPSS, as was the correlation coefficient of the participants in each group per block. These measures were used to compare the different blocks in order to test the hypotheses (figure 2).

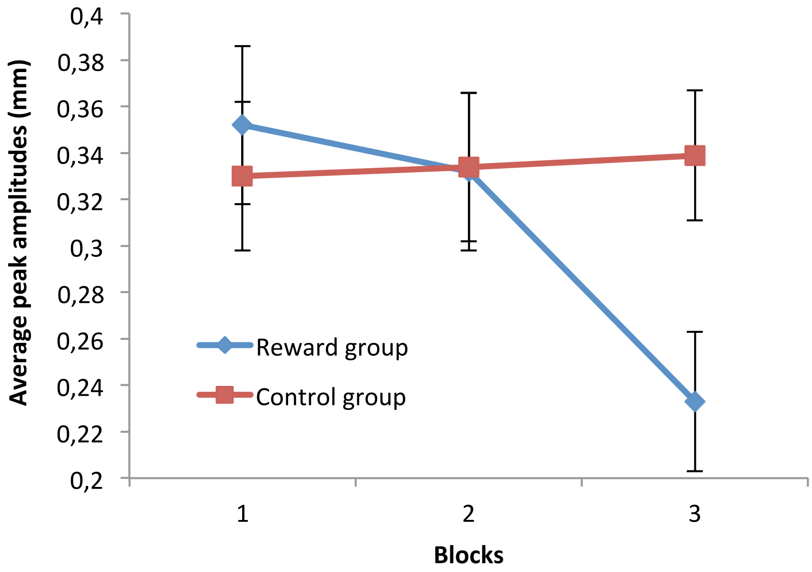
Results

Effort

The first hypothesis stated that the participants would invest more effort in block R2 and less effort in block R3. A 2 (condition) X 3 (blocks) mixed Anova was used to test this hypothesis. There was no significant effect of the experimental condition on the pupil dilation, indicating that the pupil response of the two experimental groups were approximately equal when other variables are disregarded, $F(1,32)=0.481$, $p=.493$. There is a main effect of the peak pupil dilation on the repeated measurements (block 1-3), $F(2, 64)=7.687$, $p<.001$. Furthermore, results show an interaction effect between peak pupil dilation and the experimental condition, $F(2,64)=10.282$, $p<.001$, $\eta^2=.243$. A schematic view of this interaction effect can be seen in figure 4. This indicates that the difference of peak pupil dilation between the blocks differs for the two experimental conditions. To test in what blocks these differences occur, three independent t-tests were used. As expected both conditions in block 1 performed roughly the same, no significant effect was found between the reward group (M= 0.3520 , SD=0.1347) and the control group (M=0.3298,SD=0.1348); $t(32)=0.479$, $p=.635$. Contrary to the original hypothesis there was also no significant difference in block 2 between the reward group (M=0.3320, SD=0.1473) and the control group (M=0.3336,SD=0.1249); $t(32)=-0.034$, $p=.973$. In block 3 the conditions did show a significant difference as expected between the reward group (M=0.2332, SD=0.0976) and the control group (M=0.3393,SD=0.1341); $t(32)=-2.608$, $p=.014$. Summarizing the aforementioned statistical results, it seems that after getting paid for performing a task the invested effort will drop. This is in concordance with the hypothesis that due to less intrinsic motivation the expended effort was expected to be less (although proof of a causal relation between intrinsic motivation and expended effort is lacking).

The hypothesis that expended effort in block 2 for the reward condition would be higher than average is not supported by the results. Both the reward group and the control group have almost identical average peak pupil dilation scores in block 2 (figure 4).

Figure 4: Interaction between the conditions and blocks



Legend: Error bars represent standard error of the mean scores

Liking

The second hypothesis that in block R3 the task evaluation will be lower was also tested with a 2 (condition) X 3 (blocks) mixed Anova. For liking there was no significant effect on the experimental blocks, F(2,64)=1.970, p=.148. There is also no interaction effect of liking and the experimental condition, F(2,64)=0.534, p=.589. These results show that receiving a reward for performing a task does not interfere with conscious task-liking. Hence, the second hypothesis that due to less intrinsic motivation after receiving a reward, the task evaluation in the reward group would be lower in block 3 is not supported.

Correlation between effort and liking

The third hypothesis was that there would be a correlation between effort and liking for blocks R1, C1, C2, and C3 and that this correlation would be disrupted by rewards in block R2 and R3. The mean correlation between effort and liking for all blocks can be seen in table 1. A 2 (condition) X 3 (blocks) mixed Anova was used to test this hypothesis. There was no significant main effect of the experimental condition on the correlation between effort and liking, indicating that correlations of the two experimental conditions did not differ over the three blocks when all other variables are kept equal, F(2,60)=0.861, p=.428. There was also no interaction effect between the experimental condition and the correlation score, F(2,60)=0.971, p=.385.

Table 1: Correlation between effort and task-liking

	Reward group			Control group		
	1	**2**	**3**	**1**	**2**	**3**
Mean correlation	.162	.048	-.052	.065	.037	.073
Standard deviation	.263	.302	.381	.330	.407	.255
Standard error	.078	.093	.083	.073	.088	.078

Discussion

The results show no significant increase of effort when monetary rewards are at stake. A significant decrease of effort when this reward is taken away, however, is found. No data to support our second hypothesis was found, there is no evidence found to support the hypothesis that monetary rewards decrease liking of the task. Finally, effort and liking do not seem correlated at all.

The money-effort link

In the reward condition, no significant correlation is found between money and invested effort on the task. There is a significant effect when the monetary reward is taken away. Participants who earned money in the second block did not increase their effort but did show decreased effort during the third block where the rewards were taken away. This shows that the hypothesized link between money and effort is partly found. Monetary rewards do not cause participants to increase effort in this paradigm, but decreased effort is observed when the monetary reward is taken away.

A possible explanation for why participants did not show increased effort could be due to the fact that in the reward condition participants could earn the same amount of money each trail (40 cents). Shen and Chun (2010) found that rewards can make people more flexible on different tasks, and thus to exert more effort. This effect however, was only found when the reward increased in comparison with the previous trial. When they got the same high rewards, participants would simply stick to the way they worked before and thus became less flexible. Among other experiments, they also tested this hypothesis in a visual search task, so it is comparable to this experiment. Since in this experiment the same amount of reward was given each trial, it could be that an increasing amount of reward would have made participants exert more effort on the task.

These findings do show that pupil dilation is indeed a good and reliable measure of mental effort in this setting. This investigation confirms that pupil dilation can be used as a measure of mental effort. It has especially proven its use in studies that want to investigate this precise experimental paradigm. Here this includes the effects of effort, liking and its relation with respect to monetary rewards in the case the overjustification effect could be present and in combination with the visual search task. It is a good measure especially due to its objective nature since it measures unconscious effort.

The money-liking link

Hypothesized was that monetary rewards would decrease liking for the task. A decrease in liking after the monetary reward was taken away was expected, due to the so-called overjustification effect. When people are given a reward for an activity they will attribute their behavior to the reward instead of their intrinsic motivation, when this reward is taken away, there is neither liking nor motivation left, neither intrinsic nor extrinsic.

No evidence was found that liking of the task was decreased when monetary rewards were at stake. There is also no significant correlation found between money and liking of the task. Participants in the reward group did not like the last block less than participants in the control condition.

According to research (Pretty & Seligman, 1984; Deci, 1971) external rewards decreases the interest and engagement in an intrinsically interesting activity. The task might not have been intrinsically interesting for the participants, hence the reason why there was no effect of the external reward on liking of the task.

Another explanation for the lack of data supporting the hypothesized link between money and liking could be ascribed to the idea that liking can be an unconscious and conscious experience. It could be that effort only influences unconscious liking. Berridge and Winkielman (2003) show that positive and negative affective reactions can be elicited subliminally, without any awareness of affective reaction. Overall people do not have much access to biological processes thus it could be that they actually like something but they cannot report the liking consciously. Generally, conscious liking results from interaction of separate brain systems of conscious awareness with those subcortical networks of core processes of unconscious affect. In some cases however, activity in brain systems mediating the unconscious liking may become decoupled from conscious awareness, resulting in an unconscious emotion. In future research liking should be measured with a more objective, unconscious measure. In this case it could be that liking of the task is an unconscious emotion and should thus be measured unconsciously.

The effort-liking link

Hypothesized was to find a positive correlation between effort and liking. It was thought that more expended effort would also increase the liking of the task and vice versa. The data shows no significant correlation between effort and liking meaning that participants who expended more effort on the task did not seem to like it more too. This could mean that effort and liking are dissociated in this paradigm, in any case there is no link between effort and liking found.

The absence of the correlation could originate from the fact that the liking-scale is a subjective measure in which participants make a conscious decision. As described before, liking can be an unconscious and conscious experience. It could be that liking of the task is an unconscious emotion and should thus be measured unconsciously, rather than with the subjective measure used in this experiment. This might be the reason for not finding the hypothesized relation between effort and liking.

Even though feedback was given after the participants were asked to evaluate their liking of the trial, it could also be that not effort, but performance feedback played a big part when they had to do so. Research shows (Tang and Sarsfield-Baldwin, 1991) that participants with high self-esteem liked the task more after positive feedback for performing a difficult task. Some participants made remarks after the experiment that they liked the experiment because they were good at it. In reality, participants got random feedback, which was overall positive. This feedback was consistent over all the trials so this could be the reason why there was no difference in task-liking over the different trials. The performance feedback will probably not make people like one trial better than another but will make people like the whole experiment more and thus consistently rate the same value. Tang and Sarsfield-Baldwin (1991) also found that positive feedback increased intrinsic motivation in comparison to negative feedback.

Conclusion

Although pupil dilation is found to be validate and reliable measure, there is one limitation of using the eye-tracker when it comes to data loss. The eyes of some people are harder to measure than others and sometimes the eye-tracker simply misses a data point. Seventeen out of 51 participants had to be deleted because the eye-tracker did not measure enough data points.

Even though the experiment took place in a closed room without distractions, it is expected that the results can be generalized to the "real world" because the mechanism of first rewarding someone with money for an activity, and taking it away later is no different in this setting compared to the "real world". Participants in the reward group could gain an extra 40 cents for each trail in the reward block. In total they could double the amount of money they earned since both the control and the reward condition received a standard 4 euro fee for participating in this experiment. Concluding that there really was something at stake for the participants in the reward group.

Although not all hypotheses are confirmed, this experiment can still contribute to science. A possible explanation for not finding evidence for the hypotheses could be due to the fact that liking could be unconscious and should be measured with a more objective, unconscious measure. Pupil dilation on the other hand seems to be a reliable, validate measure for effort and thus can be used in future research in similar settings. An important finding is the decrease in effort (objectively and precisely measured) on a task when a monetary reward is taken away. This confirms the idea that the amount of effort is lower for an activity after people are rewarded with extrinsic rewards, such as money. So, if you still give your kids monetary rewards for getting high grades in school, you might want to reconsider.

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