IMMEDIATE VERSUS DELAYED REWARD IN PAVLOVIAN-TO-INSTRUMENTAL TRANSFER

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Abstract

There is a growing interest in eating behaviour, partly caused by an increase in people with obesity. A 'toxic environment' plays a role in the increase in the increase in obesity rates. Multiple articles have demonstrated the effects of food rewards on eating behaviour. However, a distinction between an immediate food reward and a delayed food reward has not been made yet. Therefore, in this study, an experiment will be conducted, using the interference paradigm, to measure whether there is a PIT-effect present for immediate and delayed food rewards. The experiment was conducted among 51 students who had to perform a computer task. A questionnaire was also presented, measuring motivation. A reliability analysis was performed for the questionnaire and multiple repeated measure ANOVA's were performed on the data collected by the computer task and the questionnaire. Furthermore, an exploratory simple effect analysis was performed to look more into the interaction effect. The findings suggest that there is evidence for the presence of the PIT-effect in immediate versus delayed food rewards and that motivation plays a role when participants receive the immediate reward. However, to support this evidence, future research on immediate versus delayed food rewards needs to be done. The theoretical implication is that predict delayed rewards have no interference with our current activities. The practical implication could be that eating unhealthy and tempting food is planned for a later moment in such a way that cues in the toxic environment have less impact on our activities.

Key words: Pavlovian-to-instrumental transfer; food rewards; immediate reward; delayed reward; interference paradigm; motivation

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Introduction

The interest in eating behaviour and food has been increasing over the past few years. More and more (news) articles, programmes and books are about food, eating behaviour, and how to change this behaviour. For example, Vogue magazine shows you all the pros and cons for different eating styles (van Ede, 2018) and how to abstain from sugars during the day (van den Brand, 2019). Cosmopolitan magazine tells you how to eat less carbs (Zwanenburg, 2019), and an article in Women's Health gives you recipes for healthy snacks that still contain chocolate (Women's Health, 2019). The municipality of Amsterdam is only serving vegetarian meals on their events (NOS, 2019a), and the catering Company Sodexo sold twenty percent more vegetarian food in 2018 than the year before (NOS, 2019b). This growing interest in eating behaviour could be a result of the increase in people with obesity and the additional health problems. Since the 1980's, there has been an increase of 17% in people who are overweight in the Netherlands. Half of the growth in people who are overweight, is due to obesity (CBS, 2018). This increase in obesity rates could be caused by the 'toxic environment' that we currently live in. "Toxic environment" which refers to "aspects of western living that promote unhealthy eating and activity patterns" (Poston II & Foreyt, 1999. p. 3; Battle & Brownell, 1996). In this current environment, excessive food intake is promoted (Hill & Peters, 1998) and palatable foods and their cues can have a motivational power. The smell or sight of a cookie, or another type of food can elicit an urge to eat it, and even when you eat just a few bites of something very tasty, it can evoke an urge to eat even more of it. In a world where there is food in abundance, urges that are triggered by cues can make a person more likely to eat right now, or over-eat, even if that was not the initial plan (Berridge, Ho, Richard & DiFeliceantonio, 2010).

What drives our eating behaviour?

But what drives our eating behaviours and what influences this behaviour? Multiple factors play a role in this. For example, routines and a need to survive, but mostly, it is because we like the taste and pleasurable consequences of eating (Johnson, 2013). Previously, the interest in the hormonal regulation of the hypothalamic and hindbrain systems involved in energy regulation dominated research on feeding. However, nowadays, reward and decision making, roles for forebrain circuits in learning, and memory are more used in research on eating behaviour (Johnson, 2013). Previous research has demonstrated the effect of rewards on eating behaviour (Higgs, 2015; Johnson, 2013). Human brain imaging studies have demonstrated the activation of parts in the brain implicated in reward by using palatable food and food-related

visual or olfactory cues (Kenny, 2011). Also, in a review by Tanja, Adam, and Epel (2007), it is stated that chronic stress and unsuccessful attempts at food restriction can have increasing effects on the reward value of highly palatable food. Furthermore, an article from Berridge (1996) states that it is food reward processes that underlie the motivation for seeking out and consuming certain types of food. We learn that certain foods are good to eat, because they elicit a pleasurable hedonic response. Because of this learning process, the cues that we associate with those foods, develop the ability to attract our attention, which makes the food become more wanted (Higgs, 2015). These 'food cues' can be taste, smell and sight, and they can start influencing people's behaviour (Colagiuri & Lovibond, 2014). It has even been demonstrated that these attractive 'food cues' influence the consumption of food in a laboratory (Fedoroff, Polivy & Herman, 2003).

Pavlovian-to-instrumental transfer

A learning process that could have an effect on eating behaviour, is the Pavlovian-to-instrumental transfer (PIT). In the PIT, "two separate learning phases are used to form S-O (stimulus – outcome) and R-O (response – outcome) relations, and even though there is no S-R (stimulus – response) relation, S does gain the capacity to trigger R" (Marien, Custers & Aarts, 2018, p. 19). In the standard PIT procedure, there are three phases. The first phase is the pavlovian training, where a cue is paired with a reward, for example food, and another cue with no reward. In the second phase, the separate instrumental training, a response is learned in order to obtain the food reward. In the last phase, the transfer test, each cue is presented with the opportunity to make the instrumental response. There is a PIT-effect when in the test phase, the cue that is paired with a reward, induces a greater instrumental response than the unpaired cue (Colagiuri & Lovibond, 2014). Specifically, PIT refers to the capacity that a pavlovian stimulus has and predicts a reward to increase or evoke an instrumental response for either the same or a similar reward (Kruse, Overmier, Konz & Rokke, 1983; Rescorla & Solomon, 1967; Estes, 1943). This makes the PIT essential to understanding the behaviours that are often subject to cue control, like drug taking, and eating and drinking (Holmes, Marchand, & Coutureau 2010). The PIT-effect has previously been observed in different types of animals, for example, in rats (Holland, 2004; Boggiano, Dorsey, Thomas & Murdaugh, 2009), monkeys (Henton & Brady, 1970), and pigeons (Overmier, Ehrman & Vaughn, 1983). Even though the PIT-effect has a high presence in many aspects of our behaviour in everyday life (Holmes, et. al., 2010), it has only recently been demonstrated experimentally in humans and with different types of rewards (Talmi, Seymour, Dayan & Dolan, 2008; Paredes-Olay, Gámez, & Rosas, 2002), for example,

with drug use (Everitt & Robbins, 2006), cigarette, alcohol, and monetary rewards (Allman, DeLeon, Cataldo, Holland, & Johnson, 2010) and food (Watson, Wiers, Hommel, Gerdes & de Wit, 2017; Johnson, 2013). Current research on the PIT-effect in food rewards is mainly focused on immediate food rewards, where participants directly receive the food. For example, in the study done by Watson, Wiers, Hommel, Ridderinkhof and de Wit (2016), the participants would receive the food directly after the experiment. Furthermore, in the study done by Colagiuri and Lovibond (2014), a plastic tube would deliver individual M&M's in a plastic box within easy reach of the participant, and the participants were told that they could not take any of the chocolate with them and that they should eat it as soon as it was delivered. The questions that arise from this research is whether immediate food rewards are really more motivating than delayed food rewards, where the food is received later, and whether people are only triggered by immediate food rewards.

Present study

As described earlier, research on the PIT-effect and immediate food rewards has already been done. However, a distinction between an immediate food reward and a delayed food reward has not been done yet. In this master thesis, an experiment will be conducted, using the interference paradigm, to measure whether there is a PIT-effect present for immediate and delayed food rewards. In the interference paradigm, a participant learns information at one point in time that can conflict with information that is learned at another point in time (Bouton, 1993), and there should be a higher interference when there is an incongruence. The current experiment will consist of a computer task, and palatable food that people can eat right after the experiment, immediate food rewards, and food that they have to take home with them for later, delayed food rewards, will be used. The question being answered in this thesis is "When it comes to either receiving snacks for now or snacks for home, what role does the motivation play regarding the PIT effect?" The first hypothesis states that there is a main effect for the pavlovian cue. The second hypothesis states that there is a main effect for the instrumental response. The third hypothesis states that there is an interaction effect for the pavlovian cue and the instrumental response, which means that there is a PIT-effect present. The fourth, and last hypothesis states that there is a larger interference for the pavlovian stimuli that predict 'snack for now', the immediate reward, which means that there is a stronger PIT-effect for pavlovian stimuli predicting 'snack for now'.

Method

Participants/design

51 students participated in the experiment. They were mostly students at Utrecht University and some of those students participated to earn 0.5 participant hours. The participants were recruited via flyers that were hanging in the halls of the Langeveld Building at the Uithof (see appendix 2) or by approaching them via What's App, Facebook, or in person. Both the flyers and the personal approach described the experiment broadly as having an interest in how fast people respond to certain visual stimuli. The reward of snacks and participants hours, and the duration time were also described. The experiment consisted of 21 male participants and 30 female participants with a mean age of 21.82 (*SD* = 1.77). There were no specific terms and conditions regarding the consumption of food before the experiment. This experiment uses a 3, the pavlovian cue (Now vs Home vs Neutral) x 2, the instrumental response (Now vs Home) within subjects design

Materials

The participants were seated in a cubicle in the lab on the ground floor of the Langeveld Building at the Uithof. They were seated behind a desk, facing the monitor of a computer with the keyboard in front of them. In their left corner on the ground, there were four boxes consisting of the four snacks that the participants could pick. From left to right these snacks were; Twix, Mars, Snickers, and Bounty. Both in the computer task and in the questionnaire, immediate vs delayed was conceptualised by using the word 'now' for immediate responses and 'home' for delayed responses. A questionnaire, consisting of 7 questions, was used to measure their motivation and effort they would want to make regarding both the snack too eat now and the snack to take home for later. For the first question, the participants had to pick the snack that they liked the most. The other 6 questions consisted of 3 sub questions regarding their motivation and effort they would want to make for the snack for now ($\alpha = .83$) and 3 questions regarding their motivation and effort they would want to make for the snack to take home for later ($\alpha = .91$). A 5-point Likert scale was used, ranging from "not at all" to "very much". An example of a question asked in the questionnaire is "*To what extend would you like to eat the snack right now?" Not at all – not much – neutral – somewhat – very much* (see appendix 3). To present the stimuli and record the button presses, the software MATLAB was used.

Procedure

After providing informed consent (see appendix 1), the participants filled in a small questionnaire, which was filled in on paper. The experimenter then explained a bit more about what the participants had to do in the experiment. The experimenter also told the participants that she would be present during the whole experiment and that they could always ask questions if they did not understand something. The explanation would sometimes be given in Dutch, because Dutch participants did not always completely understand the whole experiment when it was told in English. After the explanation, the experimenter filled in all the variables in the computer programme so that the experiment could start. These variables were; the participant number, gender, age, their handedness, their group, sequence and order number and the snack that the participant had chosen.

Phase 1

The experiment started off explaining that there were four phases and that the experimenter was interested in how fast people are able to react to certain visual stimuli. The text on the next screen explained that the participants could score points, which could later be exchanged for the snack that they had chosen. The keys that would correspond with the stimuli, the 'w' and the 'o', were explained and the red cross, which appeared when the participants pressed a wrong key, was presented as well. After this, the first phase, the *demonstration phase*, was explained. In the first phase, the participant was asked to respond as quickly and accurately as possible to certain visual stimuli by pressing a certain key on the keyboard. During the actual task, the participant would, firstly, see a grey square in the centre of the screen. Then, either a star, a moon, or a cloud would appear on the grey square. Thirdly, a blue or a yellow frame

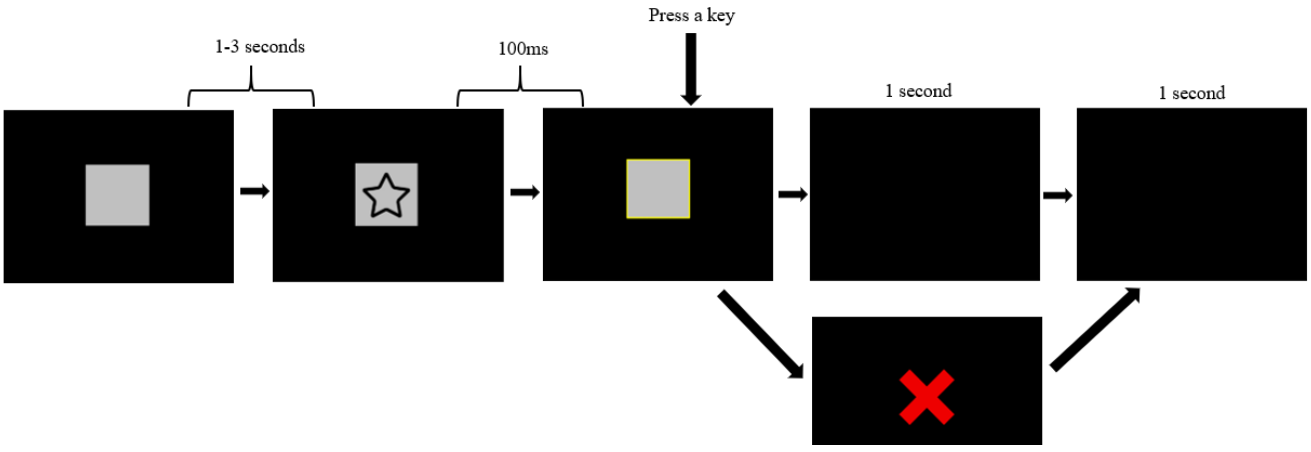

Figure 1. Visual representation of phase 1 & phase 4

would appear around the grey square (see figure 1). The demonstration phase consisted of 42 trials.

Phase 2

After performing the demonstration phase, the second phase, *the instrumental phase,* was explained. In the second phase, the participants could earn points for a snack to take home or to eat immediately after the experiment. If the participants pressed either the 'w' or the 'o', they would earn points to eat the snack now or to take home for later. After they had correctly pressed the key, they had to speak out 'snack for now' or 'snack for home', depending on which key they had correctly pressed. The experimenter kept track of whether the participants said the

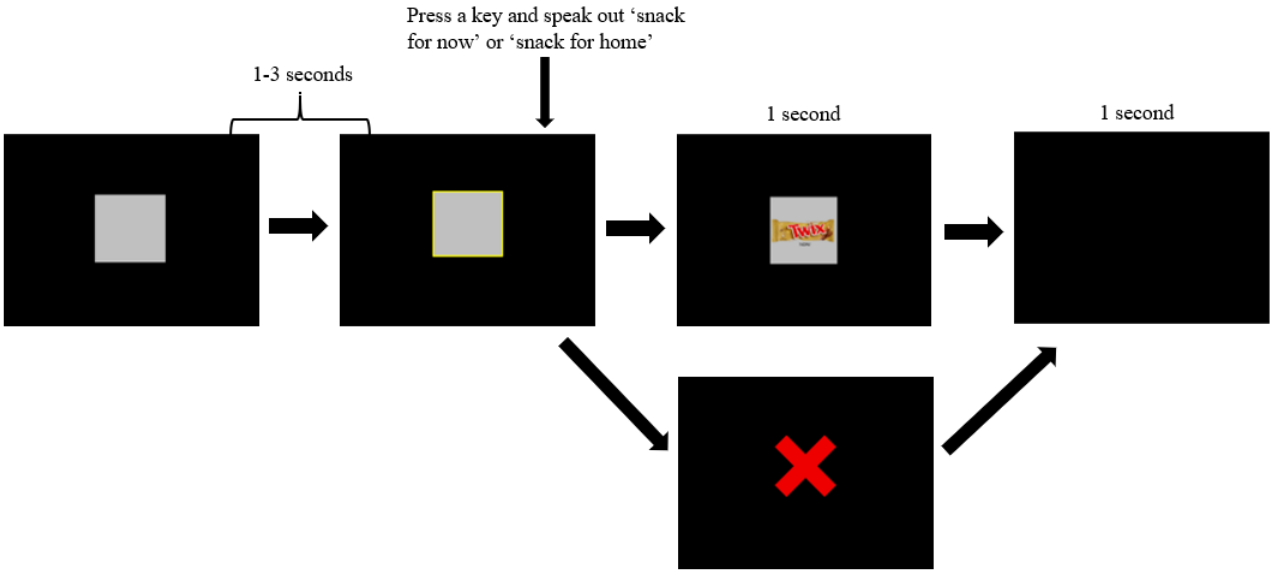

Figure 2. Visual representation of phase 2

correct sentence. So, firstly a grey square would appear. Then a blue or yellow frame would appear around the grey square. The participant then had to press the correct key and speak out. After the correct key was pressed, an image of the chosen snack with either 'now' or 'home' written under the snack would appear on the screen (see figure 2). Before the actual trials, there would be practice trials where the participants could not earn any points. The second phase consisted of 40 trials, 20 trials to practice and 20 trials where the participants could earn points.

Phase 3

In the third phase, *the pavlovian phase,* the participants did not have to press any keys on the keyboard. Their task in this phase was to remember the association between the stimuli, a star, a moon, or a cloud, and the result, points for the snack to eat now or to take home for later. The participants then had to use these stimuli to predict the potential result and speak out this potential result, 'snack for now' or 'snack for home'. The experimenter kept track of whether the participants said the correct sentence. So, the participants would firstly see a grey square, then the stimulus, either a star, a moon, or a cloud would be presented. After the stimulus was presented, an image of the snack that they had chosen appeared on the screen with either 'now' or 'home' written under the snack. There were also practice trials in this phase, where the participants could not earn any points for a snack. The third phase consisted of 40 trials, 20 trials to practice and 20 trials where the participants could earn points.

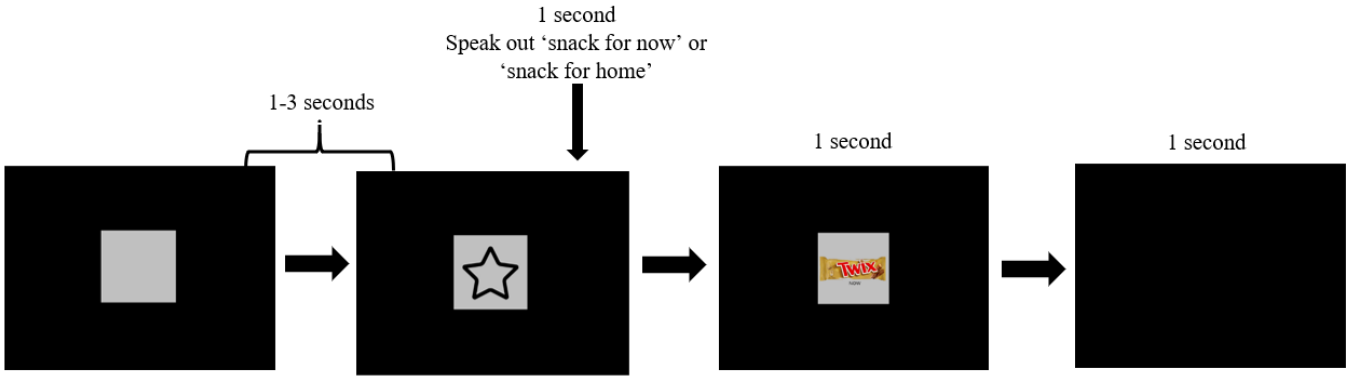

Figure 3. Visual representation phase 3

phase 4

In the last phase, *the PIT-phase,* the participants had to do exactly the same task as in the first phase (see figure 1). However, is this phase the participants could not earn any points for a snack to either eat immediately after the experiment or to take home for later. The last phase consisted of 30 trials, divided over 4 blocks.

After the participants finished the last phase, the text "You have successfully finished the experiment! Thank you for taking part. The experiment will now explain further details of the snack you have earned" would appear on the screen. Also, the amount of points that the participants had earned would appear on the screen. The experimenter would then close the experiment and hand the 2 snacks to the participants.

Data analysis

A G-power analysis, showed that 24 participants were needed for this experiment. This amount was doubled to obtain more power. The variables pavlovian cue and instrumental response had to be computed from the existing data, using Excel. All the data obtained during the experiment was saved in separate Excel files, which had to be converted to one SPSS file. The data file was also changed from a long to a wide file. Possible missing values and outliers, 1.8%, where excluded from the data. A value was seen as an outlier, when the reaction time (RT) was smaller than 100ms, or larger than 3 standard deviations from the mean RT of the participant. A repeated measures ANOVA was used to analyse the data, and an explorative simple effect analysis was used to look more closely to the interaction. Due to a shortage of time, only the fourth phase of the experiment was used in the analysis.

The Snack Question, which was used to measure the participants motivation, was put into SPSS and the Likert-scale was coded from 1 (not at all) to 5 (very much). Firstly, the means were computed. Reliability analyses were conducted and the Cronbach's Alpha's were reported to determine the internal consistency of the questionnaire. Then, the computed means were used in a repeated measures ANOVA.

Results

The experiment used a 3, the pavlovian cue (Now vs Home vs Neutral) x 2, the instrumental response (Now vs Home) x 4 (block) within subjects design. The means and standard deviations were calculated for the reaction times for the pavlovian cue and the instrumental response (see table 1). A repeated measure ANOVA demonstrated a main effect for the instrumental response, $F(1,50) = 7.94$, $p = .007$, $\eta^2 = .14$. No main effect was found for the pavlovian cue, $F(2,49) = 1.44$, $p = .241$, $\eta^2 = .03$. A main effect was found for block, $F(48,1) = 3.24$, $p = .024$, $\eta^2 = .06$. Pairwise comparisons showed only a significant effect for block 2 ($M = 397.74$, $SD = 6.86$) and block 3 ($M = 411.04$, $SD = 6.48$). No interaction was found for the pavlovian cue and the instrumental response $F(2,49) = 1.15$, $p = .319$, $\eta^2 = .02$. No interaction effect was found for the pavlovian cue and block, $F(6,45) = .56$, $p = .763$. No interaction effect was found for the instrumental response and block, $F(3,48) = .24$, $p = .867$, $\eta^2 = .01$. There was no interaction effect found for the pavlovian cue, the instrumental response, and block, $F(6, 45) = 1.56$, $p = .160$, $\eta^2 = .03$. A simple effect analysis revealed a simple main effect for the neutral pavlovian cue and the instrumental response for 'now', $F(1, 50) = 4.00$, $p = .011$, $\eta^2 = .12$. This suggests that participants reacted faster with the 'now' key when a neutral stimulus was presented. A

simple marginal main effect was found for the 'now' pavlovian cue and the instrumental response for 'now', $F(1, 50) = 7.00$, $p = .051$, $\eta^2 = .07$.

Table 1. Means for reaction times including SD

Pavlovian Cue	Instrumental Response	
	Now	*Home*
Now	*M* = 394.00(*SD*=6.92)	*M* = 405.49(*SD*= 7.01)
Home	*M* = 404.08(*SD*=7.27)	*M* = 405.81(*SD*= 8.03)
Neutral	*M* = 397.59(*SD*=7.27)	*M* = 408.60(*SD*= 7.43)

For the snack questionnaire, a mean score for every participant for both the questions regarding the snack for now and the snack for home was computed. A repeated measures ANOVA revealed a significant effect for Snack Questionnaire, $F(1, 50) = 8.94$, $p = .004$, $\eta^2 = .15$. This suggests that people are more inclined towards 'now' than 'home', which is in line with other results found in this study. The means and standard deviations were calculated for the snacks used in the experiment (see table 2). A repeated measures with the snack as a covariate, showed no interaction effect for the means for now and home and the snack, $F(3,48) = .49$, $p = .694$, $\eta^2 = .30$, which suggests that it did not matter which snack was chosen.

Table 2. Means for the 4 snacks, including SD

Snack	*Now*	*Home*
Twix	*M = 3.05, SD = .99*	*M = 3.846, SD = .81*
Snickers	*M = 3.21, SD = 1.07*	*M = 3.61, SD = 1.32*
Mars	*M = 3.29, SD = .49*	*M = 3.48, SD = .81*
Bounty	*M = 2.75, SD = .98*	*M = 3.53, SD = 1.17*

Discussion

The aim of this study, was to look for the presence of a PIT-effect in an immediate versus a delayed food reward. Therefore, an experiment has been conducted, using the interference paradigm, to measure whether there is a PIT-effect present for immediate and delayed food rewards. The question that has been aimed to answer is "When it comes to either receiving snacks for now or snacks for home, what role does the motivation play regarding the PIT effect?" In this study, a main effect for the instrumental response, but no main effect for the pavlovian cue was found. Furthermore, with regard to the interaction effect, the findings suggest that there was no interaction between the pavlovian cue and the instrumental response, which

means that there was no interference between the pavlovian cue and the incongruent instrumental response. This indicates that there was no PIT-effect. However, the findings suggest that participants responded faster with the key that was associated with 'now' when a neutral stimulus was presented and when a 'now' stimulus was presented. This suggests that, even though it was not significant, the PIT-effect did occur in the experiment. This is in line with previous research done on the presence of the PIT-effect in food rewards (Watson, et. al., 2017; Watson et. al., 2016; Colagiuri & Lovibond, 2015; Bray, et. al., 2008). Furthermore, a faster RT was found for 'now' than for 'home' (see table 1), which suggests that there was a larger interference for 'snack for now', the immediate food reward. This means that the PIT-effect that occurred, is stronger for pavlovian stimuli predicting the immediate food reward than for pavlovian stimuli predicting the delayed food reward. Because no research had been done yet on whether there was a PIT-effect present in immediate versus delayed food rewards, this finding has not been demonstrated before. An explanation for the significant effect for the immediate food reward, could be that we are currently surrounded by 'food cues' in our food-rich world. As described earlier, in a world where there is food in abundance, a person can be more likely to eat right now due to urges that are triggered by cues (Berridge, et. al., 2010). This likelihood could have made the participants in the present experiment more inclined towards 'now', the immediate food reward. When looking at the motivation, the findings suggest that people are more motivated for the immediate reward than the delayed reward. Therefore, motivation only plays a role when participants receive the immediate reward, which answers the research question described earlier.

Weaknesses & Limitations

A limitation of this study, is that this experiment consisted of noisy data. For example, the experiments were done at different times during the day, which could have had an impact on whether the participants were hungry or not. This could have had effect on their motivation. Their amount of motivation could in turn influence their RT. Also, some participants had had alcohol the night before and some were even feeling a little hangover. The consumption of alcohol can impair performances, and a generally consistent finding in investigations on the effects of alcohol consumption, is that moderate doses of alcohol can increase the reaction time (Maylor & Rabbit, 1993). So, the participants that had consumed alcohol the night before could have had an impaired performance, and slower reaction times than the participants that did not drink alcohol the night before. Furthermore, people were not screened for whether they were following diets or whether they liked chocolate. Whether participants were following diets

could have influenced their motivation (Fedoroff, et. al., 2003), and this could be the same for liking chocolate. This could in turn have had an impact on their reaction time. Lastly, no inquiry had been done on what snacks were popular among the student population.

A second limitation of this study, is that only a direct comparison has been done between an immediate and a delayed food reward. In this experiment, the immediate reward can be seen as more motivating than the delayed reward, and no effect has been found for the delayed reward. This means that there cannot be said that much about the delayed reward with certainty. Therefore, more research on the delayed reward is needed.

Theoretical & practical implication

The theoretical implication in this study is that the cues that predict delayed rewards have no interference with our current activities. So, a cue that predicts a delayed food reward has no impact on whether we would take action to get this food reward. But, as also shown in this study, cues that predict immediate rewards do have interference with our current activities. A practical implication that is in line with this theoretical implication could be that eating unhealthy and tempting food is planned for a later moment in such a way that cues in the toxic environment have less impact on our activities. This could make it easier to keep to a moderate consumption of unhealthy food. This could for example be done by creating an intervention where people learn to plan their eating behaviour. This could be beneficial for people with obesity, because they tend to have a higher attention to cues that predict food (Castellanos et. al., 2009).

Future research

For future research on whether the PIT-effect is present in immediate versus delayed food cues, the noise in the data could be reduced. This could be done to screen on whether participants follow diets, liked chocolate, and if they had drunk alcohol the night before. Also, the experiments could be done at more resembling times, minimising the impact of hunger or satiation on the participants' motivation during the experiment. Another matter for future research could be using different types of food. In this study, chocolate was used. However, other types of food, like healthier food, or savoury food, may have different results. Also, a combination of healthy and unhealthy food could be done, for example, healthy food for now and unhealthy food for later. Also, an inquiry on which snacks are popular in the study population could give more insight into what snacks to use in the experiment. A distinction between people with obesity and healthy-weight people could also be made in future research.

With this distinction it could be demonstrated whether there is a difference in the PIT-effect between these two groups. This in turn could give more insights into whether people with obesity are also more responsive when it comes to when someone will receive the food. Lastly, future research could also look at the intervention, mentioned earlier in the discussion, where people learn to plan their eating behaviour in such a way that the food cues from our toxic environment will have less impact on our consumption of tempting, and unhealthy food. This can be done by teaching people to plan eating unhealthy and tempting food at a later moment, so seeing it as a delayed reward instead of an immediate reward.

Conclusions

In this study, an experiment was conducted, using the interference paradigm, to measure whether there is a PIT-effect present for immediate and delayed food rewards. The findings suggest that there is evidence for the presence of the PIT-effect in immediate versus delayed food rewards and that motivation plays a role when participants receive the immediate reward. However, more research needs to be done in order to support this evidence. This research could, for example, look more into different types of food and people with obesity compared to healthy-weight people. The findings in this study can also give a better understanding of the impact that immediate and delayed food rewards have. I can also be of great value in helping people with creating healthier and better eating behaviour, by teaching people to plan eating unhealthy and tempting food at a later moment. As a result, the cues that we face in our toxic environment, will have less impact on our eating behaviour and this could be beneficial, not only for people with obesity, but for everyone.

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Appendix 1

Informed consent

Information letter for participants

Title of project: Reaction to visual stimuli

Dear participant,

You are interested to take part in the study 'Reaction to visual stimuli'. Before taking part in this study, it is necessary that you will confirm that you have been informed about all the details of this study. This information letter will provide you information about the purpose and content of this research project.

Objective and procedure

This project aims to investigate how fast people are able to react to visual stimuli. If you choose to take part in the experiment you will complete a computer task. You will see different visual stimuli on the computer screen and will be asked to react with certain keys of the keyboard. Some responses will be rewarded. The total experiment will take about 35 minutes.

Potential (dis)advantages

We do not anticipate any risks associated with participating in this research project. You will receive two snacks for attending.

Confidentiality of data

All data collected during this research project will be treated confidentially and will be coded so that you remain anonymous. All data collected will be stored securely and data is only accessible for the experimenters. The data will be presented in a written report, in which your identity will not be revealed. You may be sent a summary of the final report on request.

Participation

Participation in this project is voluntary and you are free to withdraw at any time, even during the study, without providing any reason. There will be no penalty for doing so. If you would like to take part in the project, please sign the informed consent.

If you have any further questions, you can ask the experimenter.
Thank you for your time.

Yours sincerely
Kaya Voskuil
k.voskuil2@students.uu.nl

Informed consent: Reaction to visual stimuli

I have read the information letter for participants. I got the opportunity to ask questions. I had enough time to decide whether I wanted to participate or not.

I know that participation is entirely voluntary. I know that I can decide not to participate at any time.

I give permission to use my data for the purposes listed in the information letter.

I know that some people will have access to my data. These people are mentioned in the information letter.

I want to participate in this study.

Name participant:

Signature: Date: __ / __ / __

For the experimenter:

I hereby declare that I have fully informed the participant of this investigation.

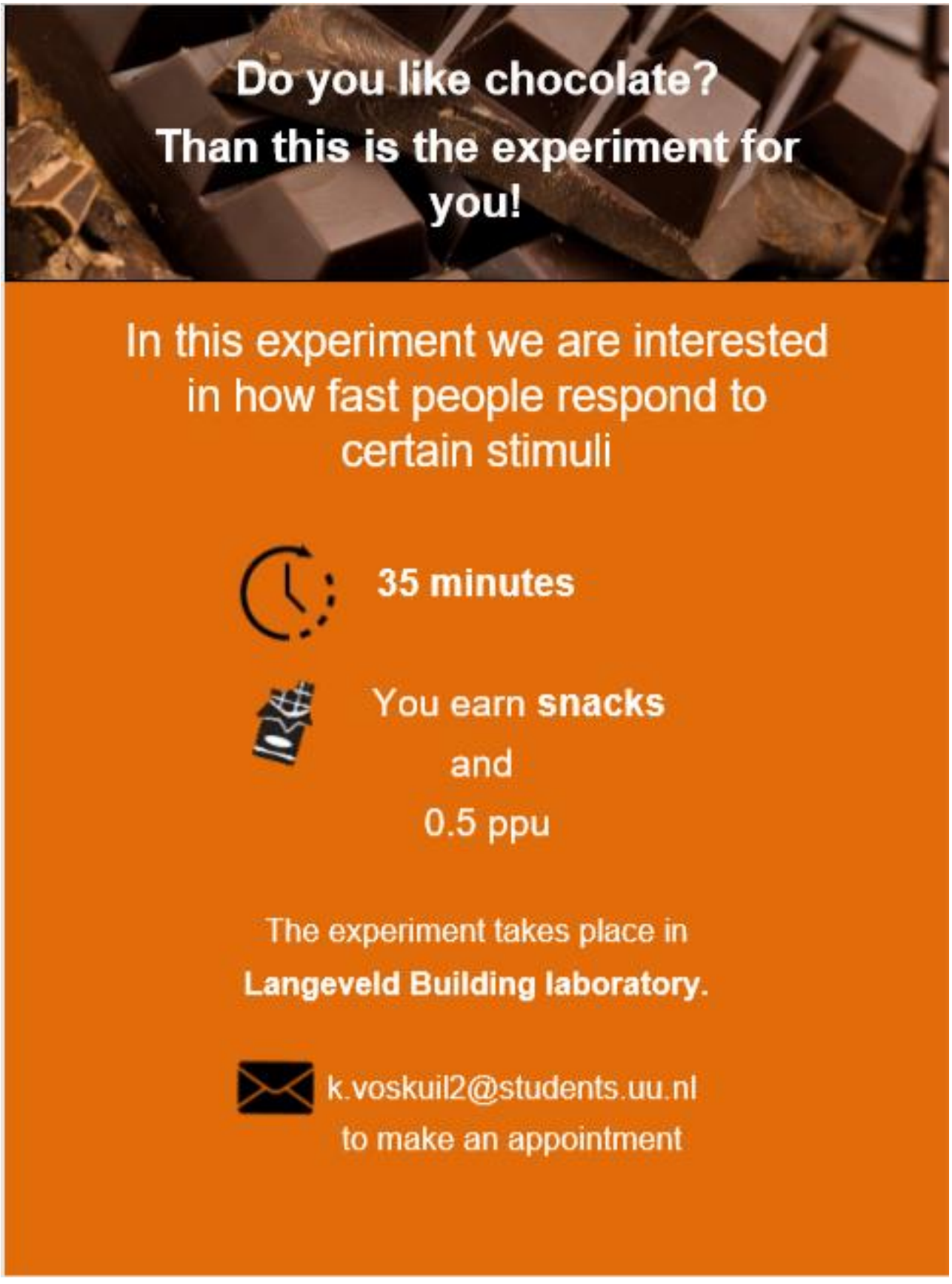
If, during the investigation, information becomes known that could affect the consent of the participant, I'll timely inform him / her about this.

Name experimenter:

Signature: Date: __ / __ / __

Appendix 2

The flyer for recruiting participants



Appendix 3
Snack Questionnaire

In this experiment, you can earn points. These points you can exchange at the end of the experiment for a real snack that you have chosen. You can choose from four snacks. Please, pick one of these snacks.

1. *Which of these four snacks do you like the most? Tick the box of that snack.*

☐

☐

☐

☐

Please tick the box that fits best with your opinion.

1. *To what extend would you like to eat the snack right now?*

Not at all – not much – neutral – somewhat – very much

☐ ☐ ☐ ☐ ☐

2. *How much effort would you make to eat the snack right now?*

Not at all – not much – neutral – somewhat – very much

☐ ☐ ☐ ☐ ☐

3. *To what extend are you motivated to eat the snack right now?*

Not at all – not much – neutral – somewhat – very much

☐ ☐ ☐ ☐ ☐

4. *To what extend would you like to take the snack home with you?*

Not at all – not much – neutral – somewhat – very much

☐ ☐ ☐ ☐ ☐

5. *How much effort would you make to take the snack home with you?*

Not at all – not much – neutral – somewhat – very much

☐ ☐ ☐ ☐ ☐

6. *To what extend are you motivated to take the snack home with you?*

Not at all – not much – neutral – somewhat – very much

☐ ☐ ☐ ☐ ☐