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Cooperative responding under concurrent schedules of reinforcement in pairs of primary school children

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Abstract

The present project employs an adapted version of the software Xadrez, developed by De Carvalho et al. (2016) and Todorov & Vasconcelos (2015). Xadrez to study choice in pairs of children under concurrent schedules of reinforcement. The experimental design was inspired by De Carvalho et al. (2016) earlier study on the effects of cultural consequences and experimental analysis of behavior of persons in groups. Their study was a replicated and extended version of Vasconcelos & Todorov (2015) studies with additional measures of variability.

Whereas previous studies used a chessboard design, a board game with a solid background will be used and the playing pieces are smiley faces (as seen in Figure 1) was used in the present study, having the aggregated product remain the same. The version of the gaming software Xadrez used in the present thesis was developed as part of Dale (2021) master thesis. Dale used version 2.11.12 in his experiment, while in this present study version 2.11.13 was used. There is similarities in the use of methods as in earlier studies.

While earlier studies (Todorov & Vasconcelos, 2015; de Carvalho et al., 2016; Dale, 2021) used university students as participants, the present study will use pairs of children between the ages of 10 and 12 as participants. The choice behavior of the children will be studied under a concurrent variable-interval (VI VI) schedule, and the focus will be to examine how the participants coordinate their responses. The study investigated if the pair managed to coordinate their responses and allocate their behavior to the alternative in the concurrent schedule that distributed reinforcement more frequently.

Keywords: *coordinated responses, choice behavior, concurrent schedules, Variable-interval schedules of reinforcement, elementary school students, The matching law, generalized matching law, social behavior.*

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COOPERATIVE RESPONDING UNDER CONCURRENT SCHEDULES OF REINFORCEMENT IN PAIRS OF PRIMARY SCHOOL CHILDREN

From a behavioral scientific view, cooperative learning is a form of group contingency; Meaning that an individual's behavior is viewed in relation to other individuals in the group. How this individual performs in the group, in addition to how the group performs as a whole, determines whether a mutual reinforcement consequence is delivered. In other words, reinforcing consequences are presented contingent on the individual's performance as a pair. It can for example be in a classroom setting where two students have to present a project that will be graded based on their performance together. Imagining that an equal amount of effort is a requirement here, the students depend on each other's performance, and the dynamic of their cooperation is what determines achieving a good grade. As Aristotle once said:

> "*Man is by nature a social animal; an individual who is unsocial naturally and not accidentally is either beneath our notice or more than human. Society is something that precedes the individual*."
>
> (Aristotle, ca. 350 B.C.E., as cited in Barker, 1998)

As social creatures living in a society, we make various decisions regarding our daily life in correlation to others. Therefore, it is of interest to study how individuals interact and behave with each other in different social settings and how individuals can achieve reinforcing outcomes from these different social settings through cooperation and collaboration with one another.

The study of Choice Behavior and Cooperative Interaction between individuals

All behavior can fundamentally be described as choice behavior. The meaning of the term choice is often understood as an act of choosing between two or more possibilities. How the term choice is defined and referred to varies in different disciplines. In psychology, the term choice is defined as the individual's mental process where options are presented and a decision-making process takes place (Catania, 2007; Cooper, Heron & Heward, 2014). Choice behavior is often described to be linked to the individual's desired intention, values, and beliefs in psychology. Within the context of behavioral science regarding choice behavior, the individual's inner thought processes and other similar elements are not factored in. Rather, what is emphasized is external factors such as environmental factors. From an applied behavioral scientific point of view, the definition of choice behavior is closer to the definition of the word decision. The word decision is linked to behavior, performance, and consequences. Because of the inclusion of external factors, this definition of choice is more apt within behavioral science. This is the definition of choice that will be used in this study.

When studying the concept of choice it is of interest to gain an understanding of how individuals make decisions. One way to study this phenomenon is by using Concurrent Schedules (CONC), which is a schedule of reinforcement where two or more responses are reinforced on different schedules at the same time. Reinforcements in a CONC operate independently and simultaneously for two or more responses (Catania, 2007; Cooper et al.,, 2014). CONC has been used in choice behavioral research as a method by applied behavioral analysts to study consequence preference. Findings from this research often create an idea of potential reinforcers operating in the organisms' environment. By using concurrent schedules of reinforcement we can gain a better understanding of the decision-making process by looking into the effects of consequences. It is especially of interest in these types of studies to

analyze how the organism is affected by the amount of reinforcement given under a period of time or quantity.

CONC is often used in studies regarding the increasing probability of a particular behavior and research that affects choice behavior. The purpose is to increase the probability of a particular behavior and decrease another particular unwanted or inappropriate behavior. In cases where the purpose is to decrease inappropriate behavior, the applied behavioral analysis creates something called a competing response. In order to create this competing response, the applied behavioral analyst has to create a controlled situation where assessments require the organisms to choose between two or more schedules of reinforcement where one response (the competing response) gets reinforced with either a higher value of reinforcement or the response is reinforced within a lower interval of time. In other words, more reinforcement in time frequently. Time-based reinforcement, also referred to as variable interval (VI) schedule of reinforcement, is a reinforcement method where reinforcement is applied after a random or average time interval. In experiments where VI-VI schedules are used the participant is provided with reinforcement for the first correct response following the elapse of variable duration of time (Cooper, Heron & Heward, 2014).

Using a classroom setting as an example, CONC and VI schedules of reinforcement can be explained as follows: In a classroom where “raise your hand if you wish to speak” is applied, the students can be picked to talk when they raise their hand and not picked when they don’t raise their hand. After a while of repeating this response pattern, the students will learn that those who raise their hands will get a chance to speak more frequently than the students who do not raise their hand. Note that the student will not be picked every time they raise their hand, but it increases their chances to get picked to speak during a class. When they get picked during a class may vary, but it is time based because the student can get picked anytime during a class which usually lasts for 45 minutes. This procedure is a

distinguishing feature of VI schedules, which is described by Ferster & Skinner (1957, p. 326) as a procedure where the intervals between reinforcement vary in a random or nearly random order. The student can for example raise their hand and get picked after 5 minutes - 17 minutes - 35 minutes after the class starts, during these 45 minutes randomly. Studies have shown that using VI as a reinforcement schedule leads to increasing the probability of organisms repeating their behavior (Fester & Skinner, 1957; Mayerson and Hale, 1984). Using a concurrent schedule in this setting can reduce students speaking without raising their hand, because the student will learn through this rule that students who raise their hand have a better chance to get picked than the ones that do not raise their hand. In this case the inappropriate behavior "not talking with consent" will decrease as a consequence and raising your hand will increase the response rate as a consequence (Gwinn, Derby, Fisher, Kurtz, Fahs, Agustine et al., 2005)

Concurrent schedules of reinforcement allow us to gain understanding on how individuals choose which schedule of reinforcement they want to distribute their response to. This schedule is strongly associated with the Matching Law theory.

The Matching law theory: predicting choice behavior

The Matching Law was first presented by Richard J. Herrnstein (1961) following an experiment with pigeons on a concurrent schedule of reinforcement. Herrnstein created an experimental setup where the pigeons could choose between pecking on either of two keys. These keys operated on a concurrent variable Interval (VI) schedule of reinforcement. Each of the keys operated independently to each other. VI schedule of reinforcement is time-based, which means that the first response after a variable time interval is reinforced. The reinforcer was grains that the pigeons would receive for pecking on the keys. By changing between different conditions with different VI schedules Herrnstein found that the relative rate of

responses matched the relative rate of reinforcement (Herrnstein, 1961; Poling et al., 2011). Through his research he formulated a quantitative model and a mathematical description of the Matching Law, as shown in Equation 1.

$$\frac{B1}{B2} = \frac{r1}{r2} \qquad \text{(Equation 1)}$$

On the left side of Equation 1, B stands for behavior for each of the keys. Here B1 Illustrates one pecking key and B2 is another pecking key. B1 often has twice (or more) as many reinforcers as for alternative B2. According to Herrnstein this leads the organism to allocate its behavior twice as much (or more) depending on the reinforcement amount of B1. R stands for the reinforcement obtained from each of the alternatives. R1 stands for obtained number of reinforcers and R2 is obtained reinforcers. Reinforcement is given to the experimental subject either in terms of time value or number of responses. The matching law is presented by Hernstein (1961) as a potential mathematical description of choice behavior that describes the quantitative relationship between the relative rates of response and the relative rates of reinforcement in concurrent schedules of reinforcement. This law has been used to gain a better understanding of the relationship of one organisms behavior based on reinforcers and according to the matching law theory the chances of an organism choosing one behavior over another behavior is equivalent to how much the behaviors are reinforced. For example if the participant obtains twice as many reinforcers on datakey 1 as in datakey 2, the organism tends to allocate twice as many responses to datakey 1 as to datakey 2. In operant conditioning, it is very common in studies regarding research of the matching law to give the experimental subject access to more than one response class, for example that the organism has access to datakey 1 and datakey 2, or more response classes datakey 1, datakey 2, datakey 3, etc. Concurrent schedules are used to gain a better understanding of how organisms allocate their behavior and responses between alternatives in order to obtain reinforcement. This

experimental design is used to gain more realistic and natural results. A considerable amount of research supports the view that the Matching Law theory describes a fundamental learning process within the mammalian brain (Myerson & Hale, 1984). In studies regarding human interaction the Matching Law can be used to manipulate concurrent schedules to influence behavior. Until now it has been used to gain a better understanding on how naturally-occurring events affect socially important behaviors (Conger & Killen, 1974; Mayerson & Hale, 1984, Reed & Kaplan, 2011). Studies of the Matching Law have been transported into studies regarding both animals and humans. Most studies that referred to the Matching Law were studies regarding behavior of individuals in different experimental settings. In studies where investigating coordinated behavior of individuals in groups is of interest, Generalized Matching Law (GML) was suggested as a better option because not all data on choice behavior is conformed to the strict Matching Law (Baum, 1974b).

GML is presented by Baum (1974b) as a modified version of the Matching Law and includes additional parameters that tok to account sensitivity and bias. It also predicts that the relative rate of responses varies linearly with the relative rate of reinforcement when *log* is transformed. The logarithm of the response ratio $\frac{B_2}{B_2}$ is platted a function of the reinforcement ratio $\frac{r_1}{r_2}$. Baum presented the GML equation as following;

$$\log\frac{B1}{B2} = a\log\frac{r1}{r2} + \log b \qquad \text{(Equation 2)}$$

In Equation 2, *illustrates* the measurement of sensitivity. Equation 2 can be interpreted as follows; when the slope indicates a sensitivity of 1 the behavior is considered to be matching. Baum (1974b; 1979) points out that it is often found that the sensitivity value deviates from

1, and therefore sensitivity value between 0.9 and 1.11 can be considered a good approximation to matching. Sensitivity values above 1.0 results in overmatching. It is more common to get results of undermatching, which is values under 1.0 and less than overmatching or matching. In Equation 2, *b* illustrates the measurement of bias which indicates unaccounted preferences. When there is no bias the value of *b* would be zero. The parameter does not deviate from zero if all variables are accounted for. In this equation *r2* indicates how much of the variance of the allocation or the responses between the two alternatives can be accounted for by the GML. The value of variance can be written either as percentage with a value between 0 to 100 or as value between 0.00 and 1.00. The majority of the Matching Law research is studied through experiments in laboratory settings and interpreted into natural settings across different species. Outside the laboratory General Matching Law to a further specter of arenas including studying behavior of humans in group settings.

Baum (1974b) studied the behavior of wild pigeons in flocks. In his experimental research he observed the behavior of twenty individual pigeons in a wooden house, which was their natural habitat and not a traditional laboratory setting. The pigeons obtained grains by pecking on two different keys. The two keys had different VI schedules of reinforcement. Only one pigeon had access to the key. The flocks pecks were analyzed as an aggregate product. In his research Baum (1974b) pointed out that it is uncertain if each pigeon allocated its responses according to the predictions of the Matching Law, and the reason for Baums quote is the lack of data for each pigeon's response. For a better prediction a set of data with the pigeons separate response is needed. However the data analysis from Baums experiment demonstrated that the majority of pigeons in the flock responded to the richer alternative, which was the key with the VI schedule that distributed the grains the fastest. Baums research

did not specify any specific vaciarance of sensitivity value, but highlighted that the ratio of the pecks was approximately equal to the ratio of reinforcement.

The phenomenon of the Matching Law has been of relevance in various studies with different species under different circumstances. Applying the Generalized Matching Law to interpret coordinated behavior of children when working in groups of two provides some insight to understanding of how we can increase one type of response or reduce inappropriate behavior (Borrero & Vollmer, 2002; Mayerson & Hale, 1984). These findings can be useful for understanding coordinated responses between individuals within one specie (for example interaction between pigeons and interaction between humans), but to further understand coordinated responses within a human subject we must have some understanding of what other factors may influence and affect individuals responses when there is required interaction and cooperation.

Understanding social behavior on a group and individual level

B. F. Skinner (1953) described social behavior in his book "Science and Human behavior", as "the behavior of two or more people with respect to one another or in concert with respect to a common environment". From Skinner's point of view the behavior of an individual is consequent to the behavior of the other individual in a social setting where the individuals socialize. He highlighted that humans as species are social organisms, and therefore are dependent on each other. Skinner discussed the principle of "selection by consequences", which he used as the premise for all acquired and continued behavior that is demonstrated. The selection by consequences theory can be explained in three different levels (1) phylogeny, (2) ontogeny and (3) cultural selection. Phylogenetic level is selection that occurs over evolutionary time, Ontogenetic level is selection that occurs during the lifetime of the individual, involving physical, psychological and social development etc. As distinct

from phylogeny, the ontogenetic level includes developmental history of the individual within its own lifetime. In relation to phylogenetic level which refers to the evolutionary history of a species. The last level is cultural selection which is about the selection of cultural practices and explains an individual's behavior as a function of its consequences in social settings. From this point of view cultural selection is a phenomenon that occurs when one behavior is passed from one individual to another. Cultural selection can also be explained as a result of the natural environment as part of phylogenetic events (Carvalho & Sandaker, 2016). It is often behavior that the previous generation has had benefited from. According to Skinner's social theory of selection by consequences, organisms imitate behaviors that provide the most satisfactory result in the form of success or reward. Satisfactory results increase the chance of the behavior being repeated, on an individual level. On a group level, individuals continue or repeat behavior that gives successful or satisfactory outcomes through socialization.

This happens when for example a group member (Person 1) imitates the other group member's behavior pattern, because the group member (Person 1) has learned, often through observation, that the specific behavior gives the best possible outcome. This is what Skinner meant by explaining social behavior in groups. He highlighted in his article that group behavior is a result of individuals' behavior in groups (Skinner, 1953; 1959). Various studies have supported Skinner's theory, and it is proven in later studies that consequences can be reinforcing stimuli for individual behavior of members in a given group (Carvalho & Sandaker, 2016; Conger and Killen, 1974; Glenn, 2004). Carvalho & Sandaker (2016) point out that consequences are not scheduled for the group as a unit, moreover they are behaviors that are maintained by individual consequences, which can still affect the evolution of the groups cooperation, social movement, competition and sharing and social culture.

Research question

This study will focus on coordinated responses from four pairs of children between the ages of 10 and 12 under a concurrent variable-interval (VI VI) schedule. The results from the experiment will demonstrate if the coordinated responses of the four pairs were sensitive to changes in rates of reinforcement and if they were under the control of each other's responses.This is an empirical study where choice behavior is investigated through a gaming software program. In this gaming software program the children, who will be referred to as participants going forward, will be able to place their playing pieces next to each other based on two alternatives. Reinforcement in the two alternatives will be delivered on a VI-VI schedule.

The experimental design is inspired by De Carvalho et al. (2016) earlier study on the effects of cultural consequences and experimental analysis of behavior of individuals in groups. Their study was a replicated and extended version of Vasconcelos & Todorov's (2015) studies with additional measures of variability, in addition to Dale (2021) choice of software design.

The research question will be studied through the use of an adapted version of the software Xadrez, developed by Carvalho et al. (2016) and Todorov & Vasconcelos (2015). Xadrez is used as a tool in this thesis to study concurrent schedules of reinforcement and choice behavior in pairs of children. The version of the gaming software is an updated version of Xadrez v.2.11.16, called Xadrez v.2.11.13. The older version was developed by Fredrik Dale (2021), which was used in his empirical study that investigated choice when the response unit was the coordinated responses of two individuals exposed to concurrent schedules of reinforcement. There will be similarities in the use of methods as in these earlier studies, only with a change of study group and some adjustments to better adapt for the children who will be participating in the research. In previous studies, a chessboard design

was used, and the pieces in the game moved like a knight in a chess game. In this version however, the game board game will have a solid background, and the playing pieces are smiley faces (as seen in Figure 1). This change in design will not affect the aggregated product. Players will take turns in moving the pieces so that they meet at any two adjacent cells on the board. This can be either horizontally, diagonally, or vertically. The players will receive a message at the end of each round that will either be “CONGRATULATIONS” or “End of the trial”. The goal is to reach the former as many times as possible.

There were also temporal changes in the experiment procedure. The temporal change was due to the choice of the participant group. The most recent study had a longer experiment duration; usually lasting between 2 and 3 hours on three separate days (Dale, 2021). In this present study, there were five separate experiment days, where each experiment lasted for 35 minutes. The 35 minutes consisted of five sessions, where each session lasted for seven minutes. The total duration of the experimental procedure was 175 minutes, in the span of five days. Compared to earlier study by Dale (2021) this present study has shorter temporal duration under each concurrent VI-VI schedule of reinforcement.

Earlier studies (Todorov & Vasconcelos, 2015; de Carvalho et al., 2016; Dale, 2021) also used university students as participants, in this present study pairs of children between the ages of 10 and 12 will be used as study subjects. The choice behavior of the children will be studied under a concurrent variable-interval (VI VI) schedule, and the focus will be to examine how the participants' responses are correlated to reinforcement distribution in a concurrent variable-interval (VI VI). The results will demonstrate if the coordinated responses of the four pairs were sensitive to changes in rates of reinforcement and if they were under the control of each other's responses. The reinforcement in the concurrent variable interval (VI) schedules is simultaneously available for the participants.

The purpose of this present study was to perform an experimental behavior analysis by creating a controlled choice situation where the pairs of children were presented two response options through a gaming software. This project was an empirical study aimed to investigate the choice behavior of children in primary school and to examine if they were sensitive to reinforcement and if they coordinated their responses using a concurrent VI-VI schedule of reinforcement. The experimental design was to measure the participants' individual responses and responses as pairs as they were under different VI-VI schedules of reinforcement.

Literature search and limitations

The literature search was limited to mostly empirical articles about coordinated behavior of individuals in groups and the criteria was that their behavior was reinforced Under concurrent variable interval schedule of reinforcement. The inclusion criteria were that the articles and publications investigated coordinated behavior and joined responses of more than one individual; this meant that data points had to be the result of at least two subjects in an experiment, for example, two individuals solving a task together. Both studies about animals and humans were used in this thesis (Baum, 1974b, Herrnstein, 1961; Vasconcelos and Todorov, 2015). Single case studies were excluded, for the reason that group behavior studies and joined responses of individuals in groups were themes that were more of interest for this research. The research results were also limited to the Norwegian and English language. Researchgate, google scholar, Oria, and EBSCO were used as main databases to find articles relevant to the research question. The following terms were used in the research process: matching law, generalized matching, concurrent reinforcement schedules, choice behavior, and coordinated behavior of individuals/persons in groups.

Method

Participants and recruiting procedure

Eight primary school students from Veitvet primary school, four girls and four boys between the ages of 10 and 12 participated in this project. The participants were primary school students from 5th and 6th grade. Parents of the students, teachers, and the school administration gave consent for the participants to join the project for educational purposes. The recruitment process consisted of three steps. Step 1 was to inform the children in 5th and 6th grade (children between 10 and 12 years) about the project. The children were informed about the project in class. They received two letters with information about the project. A simplified version adapted to the student's reading ability (see Appendix 1). The second information sheet was for the parents at home (see Appendix 2), since the participants were underaged they needed approval from their parents to participate in the experiment. Parents were informed that participating in this experiment means that the child will attend the experiment on six separate days (including a pilot round) and that the experiment would last for 35 minutes each day, 175 minutes in total. Children and parents were also informed that the child had the right to withdraw at any time and that there are no obligations to remain in the experiment, nor would declining to continue the experiment have any consequences. A consent form was attached to the information, which was signed by the parent of the child in order for the child to participate. Step 2 was to make a list of the students who wished to participate with their parent's consent. Step 3 was to choose who got to participate in the project. Twelve participants were randomly selected from this list. As the experimenter, I did

not participate in the choosing of what students would participate due to my relation to the study group, which caused me to be biased. Out of these twelve participants eight were chosen based on their availability in relation to the school's timetable. The remaining four participants were reserve participants in case some of the selected students would resign.

Apparatus

The laptop in use was equipped with an adapted version of Vasconcelos and Todorov (2015) software "Xadrez" version 2.11.16, a software designed in Visual Basic for Applications in Excel. The adapted version "Xadrez" 2.11.13 was used to perform the experimental task and to collect data, which is the newest version used in recent studies of cooperative responding under concurrent schedules of reinforcement (Dale, 2021). All the results from the experiment were transferred from the Lenovo ThinkPad X250 laptop with a memory stick to a password-protected MacBook Pro Retina (13,5 inch), early 2015 model.

Setting

Experimental sessions took place in a reserved room (directly translated. Group room) located at Veitvet primary school in Oslo, Norway. Figure 2 illustrates the setup of the experimental room. As shown in Figure 2, the pair were seated next to each other in front of a computer screen with a special keyboard connected to the computer. On this keyboard there were only four keys: two arrows pointing to the right and two arrows pointing left. As seen in Figure 2, the participants each had two sets of arrows to use placed on the opposite spot of the keyboard. These were used to control the playing pieces in the gaming software. The keyboard was connected to a 12.5-inch screen Lenovo ThinkPad X250 laptop. The laptops were placed on a table in front of the participants and were equipped with two chairs for the

participants to sit on while playing the game. An experimenter was in the room during all sessions, usually seated in the back of the room to observe their activity.

Design

In this present experimental research, three variables of interest were measured. The dependent variable was the participants' joint distribution of the responses to the two alternatives on the board. The independent variable was the distribution of reinforcement in each alternative. Points were received by placing the pieces in a meeting location. The place where the pieces met, which was another variable of interest, is called aggregate product (AP). During the data analysis procedure these three variables of interest were observed. These variables were considered as possible byproducts of reinforcement operant behavior that might occur with aggregate products as results of interlocking behavior contingencies.

Experimental procedure

The participants were paired beforehand during the recruiting process. They were paired by what grade they were in and by gender. During the recruiting process, most of the participants wished to participate with the same gender and play with the same age group. Therefore during pairing, the girls of the same age were paired together and the boys of the same age were paired together. The pairs played the game one at a time.

Figure 2 illustrates the setup of the experimental room. The participants were seated next to each other in front of a computer screen with a special keyboard connected to the computer (See figure 2). Before starting the experiment the participants were given instructions on how to play the game verbally by the examiner (see Appendix 3). They were informed that the goal was to earn as many points as possible in the game by moving the playing pieces next to each other in the gray squares at the top of the screen. Each time they

placed their piece on the gray squares they increased their chances to receive a point. After some meetings, they would get the message “You have received one point”, followed by the pieces being reset to the starting position. The participants were told that the more meetings they achieved the higher the possibility was to earn points, in other words, more meetings equaled more points. Participants were not aware that points were introduced according to concurrent schedules of reinforcement with variable-interval schedules (VI).

The participants started playing when the experimenter told them to start the game. This was done verbally by saying “you can now begin the game”. Figure 1 is a screenshot of the Xadrez version 2.11.13 gaming board. As seen in Figure 1 picture A two smileys were shown at the bottom of the game board, which was the starting position of both participants in the game. Each player controlled a smiley, one participant played the yellow smiley and the other participant played the red smiley. The gray squares at the top of the screen was where the playing pieces could be placed. The blue square indicated whose turn it was to play. Picture B and C illustrates how the playing pieces could move around on the board. The players could choose to either place their piece in the right square by pressing the right key or the left square by pressing the left key on the keyboard. The players were informed beforehand that placing the pieces next to each other increases their chances to receive a point. However, they were informed that they would not earn a point *every time* they placed the pieces together. When the pieces were placed together, the game would reset to where they started. When a point was received, a message would appear on the gaming board, as seen in picture D.

Compared to the earlier software Xandrex version 2.11.12, this version had a different message when a point was received. In this version when a point was earned the pair would have the message “You received one point” pop up on the screen (see figure 2, picture D).

All four pairs of participants performed five experimental days. Each experiment day consisted of five sessions with a duration of seven minutes for each session. A session lasted a total of 35 minutes (7 minutes x 5 sessions = 35 minutes). The entire experiment lasted 175 minutes in total. The experiment was planned to be executed during a two-week period, where the students played the game three times a week with less than 2 days between the experiment day. During the experimental period, some of the participants had a 3-day break between the experimental days because one of the pairs was absent due to COVID-19 testing.

All the pairs went through the full five VI-VI schedules of reinforcement VI 10s - VI 10s, VI 20s - VI 10s, VI 10s - VI 20s, VI 40s - VI 10s and VI 10s - VI 40s, but the order of the VI-VI schedule combinations was different for each pair. Table 1, gives an overview of the VI-VI schedule combination for each pair. It was a coincidence that Participant AB and EF started with a VI 10s - VI 10s reinforcement schedule. The rest of AB and EF VI-schedule values are different from each other.

Note that the participants were not informed *how* they could receive points, but *when* they could receive points was not mentioned. Participants were also told not to communicate with each other during the experiment. Additionally, they were told not to form strategies during the breaks and in between the different days of participation. The experimenter was present during these breaks to ensure that the participants did not discuss the game during the experiment and between the breaks. However, it was expected that there would be some communication about the experiment outside the experiment room considering the age group and that they attend the same school. See the chapter about experiment limitations and weaknesses (p. 27). Lastly participants were told that they could take a break after sessions if needed, but that their first planned break would be after three sessions. All participants completed all 25 sessions. Experiments were done under carefully controlled conditions

which were in no way harmful for the children. The children were informed that they had no obligation to finish the experiment if they did not want to continue.

Overview of the participants VI-VI schedule combinations

As seen in Table 1, Participants 1 and 2, referred to as AB had the following VI schedules of reinforcement VI 10s - VI 10s on session one, VI 40s - VI 10s on session two, VI 20s - VI 10s on session three VI 10s - VI 20s on session four and VI 10s - VI 40s on session five.

Participants 3 and 4 referred to as CD had the VI-VI schedule combination VI 10s - VI 40s on session one, VI 20s - VI 10s on session two, VI 40s -VI 10s on session three, VI 10s - VI 10s on session four and VI 10s - VI 20s on session five.

Participants 5 and 6 referred to as EF had VI 10s - VI 10s in session one, VI 10s - VI 20s in session two, VI 10s - VI 40s in session three, VI 40s - VI 10s in session four, VI 20s - VI 10s in session five.

Participant 7 and 8, referred to as GH had VI 10s - VI10s in session one, VI 10s - VI20s in session two, Vi40s - VI10s in session three, VI20s - VI 10s in session four and VI 10s - VI40s in session five. Note that s stands for seconds. For example VI 10s is variabel interval with 10 seconds before receiving reinforcement.

Guidelines and ethical approvals for using children in research

This research project has been approved by the Norwegian Center for Research Data (NSD) and will be carried out in accordance with the guidelines for The National Research Ethics Committee for the Social Sciences and Humanities (NESH, 2016, 13) on informed consent, privacy, and confidentiality. See Ref.nr. 231870

Ethical challenges

Children in research are a vulnerable group, and therefore it is important to create an environment that protects and safeguards their rights. It has been taken into account that the children who participate in the project can not consent themselves given their young age and are thus unable to fully express their rights and interests. Because of this, parents must give consent for the child's participation in the project, cf. the privacy scheme art. 4 and 7 (NSD).

The participants received a letter with information about the project's contents and purpose, cf. art. 12.1 and art. 13. The information leaflet was divided into two parts, one for the child (Appendix 1) and one for the parents (Appendix 2). The contents of the information sheet are adapted to the printer, Appendix 2 is an elaborate version of Appendix 1. The sheets are intended to be adapted to the level of the reader. The aim was that the information letter was readable to both the child and parents in order to understand the content and purpose of the research, cf. art. 15. The information letter contained a consent form to the guardian, which gives approval of the child's participation in the project and has understood that the participant and/or guardian can withdraw their consent at any time during the project period. Consent is necessary to "clarify the researcher's responsibilities and to ensure the research beneficiary's rights" (NESH, 2016, 15). The consent was given by the parents through the submission of a consent form by physical receipt or digitally via the school's communication platform Microsoft Teams. The consent must be documentable, either by physical submission or digital storage of consent (written or verbal).

Institutional guidelines

Since the selected target group were students at Veitvet Primary School, there was a requirement that the institutional guidelines at Veitvet Primary School were followed in the same way as the requirements in the Privacy Ordinance on correctness (art. 5.1 d), integrity,

confidentiality (art. 5.1. F) and security (art. 32) was followed (NSD; NESH, 2016). This was fulfilled by the research process by taking place in a way that meets the requirements for internal guidelines at Veitvet Primary School. Prior to the data collection, it was clarified with the school management that the implementation of the research project had been approved and that it was appropriate to carry out the research project during school hours. It was approved as long as it was adapted to the student's timetable by agreement with the student's teacher.

Results

The software Xadrez 2.11.13 recorded the response pattern of the participants. Including how the participants responded individually, which field they chose to place the game piece and the response behavior in pairs, how often they coordinated their responses. The data analysis is based on data from Table 1 (p. 37) and Table 2 (p. 40). Table 1 gives an overview of the participants' response ratio and reinforcer ratio as pairs and Table 2 is an overview of the pairs individual response ratio. Reinforcer ratio (S+) was calculated by dividing S+ left, which is the number of reinforcers obtained from the left side of the playing board divided by S + right, the number of reinforcers obtained on the right side of the gaming board. The Response ratio was calculated by dividing responses on the left side (R left) with responses on the right side (R right). R right and R left Left represent coordinated responses on the possible placement of the playing pieces which is the right side of the game board and left side of the gameboard, as seen in Figure 1. The schedules of the reinforcement field in Table 1 and Table 2 shows how the participants responded under different concurrent VI schedules of reinforcement. Tables include data from all five experiment days, each experimental day had five sessions, each session lasted for 7 minutes. All participants completed a total of 25 sessions, equivalent to 175 minutes, excluding breaks in between sessions.

To examine if there was coordination between the participants' responses the log transformation of the reinforcement rate needed to be calculated. This data is represented in Table 2, which illustrates the log transformation data of the individual response ratio for each pair. The results from the log transformation data is represented in Figure 4. The black line in Figure 4, represents P1 LOG, which is the log response ratio of participant 1 and the gray line represents P2 LOG, which is the log response ratio of participant 2. Log transformation of the response ratio is shown on the y-axis plotted by sessions in x-axis. On the y-axis values above 0 represent participants log response rate on the left side of the playing board, and values below 0 represent participants log response rate on the right side. Under the x-axis are all concurrent VI schedules of reinforcement, one for each experimental day.

The data from Figure 4, can be interpreted as follows: cooperative behavior is shown when there is a low log response rate difference between the black line and gray line. Examples of cooperative behavior are illustrated in pair CD VI 20s - VI 10s schedule, on the second experiment day. Long difference between the log response rate of participant 1 and participant 2 corresponds to low cooperative behavior. An example of data that corresponds to low cooperative behavior is the distance is shown in data from pair GH day five. As seen in Figure 4, there is some distance in log response ratio between participant 1 and participant 2, compared to par CDs data.When there is cooperation the line representing P1 LOG and P2 LOG are much closer in response ratio value. If we evaluate the diagrams in their entirety for the various groups, we see a result that indicates that the participants were not under control of each other's behavior. Meaning that they were not cooperative. But according to data from individual sessions there are some cooperative response patterns. For example in Figure 4, we can see that pair AB had a cooperative response pattern on day five (VI 10s - VI 40s), session 1 to 4 and CD on day two (VI 20s - VI 10s) and day 3 (VI 40s - VI 10s). However, the pairs were not sensitive to reinforcement.

The response pattern of pair AB, CD, EF and GH is illustrated through a cylinder diagram in Figure 5, that shows the absolute number of responses under different VI-VI schedules of reinforcement. The bar graph shows how the pairs responded in each session. Figure 5 is used to provide data on how many times they responded as a pair on the right and left side of the gaming board compared to the VI-VI schedule they were under.

Data show some similarity in response behavior in experiment day one. Where the pair AB, EF and GH responded almost as much on the right side as on the left side, ss expected response behavior in a VI 10s - VI 10s schedule. CD showed the same response pattern with a VI 10s - VI 40s schedule with a slight more response on the left side. CD was one of the pairs with data of a response behavior where there were a high number of responses on the richer reinforcement alternative compared to the other participants, except from the last experimental day were more responses on the non-richer reinforcement alternative. The results for pair CD show that the pair responded more in the richer alternative on experimental day four, but in the non-richer alternative on day five. On day five CD was under a VI 10s - VI 20 schedule of reinforcement and responded on R right in all 5 sessions, see red marks in Table 1. Notice that the richer alternative was on the right side three experimental days in a row. Which might have affected the response behavior.

Results from the last 10 sessions of pair AB, EF and GH did allocate their responses to the alternative with the best chance of reinforcement. Results shows that participants responded more to the richer alternative in 13 of 16 sessions, excluding the VI 10s - VI 10s schedules (See Figure 5 and Table 1). Despite this behavior allocation there were not much difference between the number of responses in the richer alternative and non-richer alternative to conclude that the participants were sensitive to reinforcement.

Figure 6 is data of the log transformation of the pairs response ratio and reinforcement ratio made into a linear regression diagram. This data is used to illustrate how cooperatively

the participants responded to the concurrent VI-VI schedule. By using this diagram we can gain a better understanding of between the pairs response patterns and dependent and independent variables. The dependent variable was the participants' joint distribution of the responses to the two alternatives on the board, referred to as Log R and the independent variable is the points delivered contingent on where they met, represented as S+ in Table 1. The log transformation data values of the responses (log R) and reinforcement (S+) was transferred into a linear regression diagram. Each data point in the linear regression diagram represents one session. Datapoint above zero represents R left and below zero represents R right. The y-axis shows the log reinforcement ratio and the x-axis shows the log response ratio. Y, is the mathematical symbol used to verify the possibility of matching and bias behavior. The regression line shows overmatching in three of the four pairs, while the fourth pair shows matching but insensitivity to reinforcement. Pair AB, CD and GH's data showed sensitivity values of 1.24, 1.06, 4.22, and 3.44. Bias value of the pairs was 0.23, 0.10, 0,03 and 0.01. According to the Matching Law sensitivity value of 1 indicates matching, sensitivity value 1 or less indicates undermatching and over 1 as overmatching. In view of Baum (1974b) values between 0.9 to 11.1 also indicate matching. CD was the only pair that had a regression line that showed matching, the rest of the pairs had sensitivity values of 1.24, 4.22, and 3.44, which indicated overmatching. CD had a sensitivity value of 1.06 which is matching according to Generalized Matching Law, but their data indicated that the pair were not sensitive to reinforcement. CDs data indicates that they were biased in their choice making process. Pair AB was close to matching with a sensitivity value of 1.24. In Figure 4, their data shows that they both did respond mostly on the left side of the board, and mostly on the right side in the last five sessions. The data in Figure 4, shows that there was low correlation in the beginning of the project period (experiment day 1-3), and more correlation between the response rate on the last two experiment days. Pair GH and EF had sensitivity

value 4.22, and 3.44, which is overmatching. Pair EFs response pattern shows that they were not biased when allocating their behavior to the different alternatives, because they respond continuously to both alternatives on the board. The same response pattern is shown in pair GHs results. GH did however show more correlation than EFs results (see Figure 4), and have a higher number of responses on the alternative that distributed reinforcement more frequently.

Other variables possible impact

It is important to emphasize that this was not an observational experiment, but that reporting suspicious behavior can be of value in relation to analysis and interpretation of results.

It was observed that participants tried at times to communicate verbally or nonverbally through eye contact, by looking at where they wanted the partner to move the piece or communication through body language by pointing in the direction they wanted the piece to be placed. The children had been told in advance that communication was not allowed, but still tried to find ways to share their strategies. Sometimes this was an attempt at cheating, other times they described it as a "reflex" to communicate with their partner. This was something pair AB, CD and GH told orally as feedback. Often one of the pairs was more communicative than the other. This dynamic was observed between participant 1 and participant 2 in pair AB and CD. There was not observed communication between the participant in pair EF and GH.,

Discussion

The purpose of experimental behavior analysis is to create controlled choice situations where the one response of two or more response options is reinforced to study the effects on behavior. This project was an empirical study aimed to investigate the choice behavior of

children in primary school and to examine if they were sensitive to reinforcement, while their responses used a concurrent VI schedule of reinforcement. The experimental design was to measure the participants' individual responses and responses as pairs as they were under different VI-VI schedules of reinforcement. The procedure of this study is a replica of Dale's (2021) research with a few changes in order to facilitate the research for the present study group. An adapted version of the software Xadrez was used, which was the same program used in all three studies. The present study used the same game board as Dale in the experiments, unlike Todorov & Vasconcelos and De Carvalho et al., which used a chessboard looking gameboard to measure the participants movement.

Results from this present study show that children allocate their responses proportionally to obtain reinforcement, and these responses are mostly distributed to the alternative in the concurrent schedule that produces reinforcement more frequently, as seen in Figure 5. This response pattern is equivalent to the response pattern of the participants in previous studies. According to the Matching Law, organisms allocate their responses proportionally to obtain reinforcement. However, they did not distribute enough responses to the alternatives in the concurrent schedule with the richer alternative to prove that they were sensitive to reinforcement.

Data from the experiment calculated a sensitivity value of 1.24, 1.06, 4.22, and 3.44. According to Baum's Generalized Matching Law theory these results indicate that three out of four pairs had results that showed overmatching. Only pair CD had sensitivity values between 0.9 and 1.11, which indicates matching. The difference in results is highlighted in Figure 6, which illustrates the pair's results in a linear regression diagram. In this diagram, the log response ratio is plotted against the log reinforcement ratio for all four pairs. The results also show that some of the pairs were biased to one of the alternatives, sometimes regardless of where there was the most reinforcement frequency. This response pattern was

noticed in pair CD and AB results. Especially in pair CD's results can we see that they responded as a pair more to the left side than the right side even though the reinforcement was more frequently on the left side of the board. This can be interpreted as a bias response pattern. Pair AB and CDs results also indicated coordination between the participants' responses. In the last session of pair AB, and in session three and four of pair CD's results, we can see some cooperation between the participants. By viewing the results in entirety, there was too much distance between the participants' logarithmic response rate for the results to be interpreted as cooperative behavior in the other two pairs. EF results show the least coordination between the participants in the group. Figure 4 highlights how in pair EF, participant 1 and participant 2 responded on both sides of the board but not in coordination with each other. On the other hand, they did as a pair respond mostly on the richer alternative, as shown in Figure 5.

To further understand the behavior of the participants individually and collectively we need to compare how the results are illustrated in Figure 4 and Figure 5. According to Figure 4, the participants did respond collectively to the alternative in the concurrent schedule that produced reinforcement more frequently. But when we view their responses individually in Figure 5, we notice that they did not coordinate their behavior to archive reinforcement.

The pairs log transformation data in Figure 6 shows a correlation values (R^2) of 0. 88, 0.80, 0,95 and 0.82. This value is a calculation that illustrates if there is correlation between the pairs responses and reinforcement in each session. According to these results, EF had the highest score in correlation value. In Figure 5, we can get a view of this correlation by looking at their number of responses under all VI-VI schedules of reinforcement. Their response patterns were not biased. In comparison to pair CDs they responded frequently on both sides, but mostly on the richer alternative. Another interesting finding in pair CDs results was their response pattern across the experiment days. In Figure 5, the pair responded

frequently on both sides under VI 10s - VI 40s, a little more on the right side under VI 20s - VI 10s and continued distributing responses mostly on the right alternative even on the VI 10s - VI 40s reinforcement schedule. A noticeable behavior pattern in CD is the shaping effect that might have occurred because of the order of the concurrent VI-VI schedules. The same effect is slightly observed in pair AB and GH response patterns, which had an increase in number of responses on the right side as an effect of having a richer alternative on the right side in earlier sessions. This choice behavior is noticed in Figure 5, AB on experiment days 2 and3 and GH on experiment days 3 and4. What can be of value in future research is to organize the order of VI-VI schedules of reinforcement, where the richer alternative is on the same side in order to archive a higher number of responses on the VI schedule that distributes reinforcement more frequently.

In regards to the VI-VI schedules with a high timevalue difference and low difference rate in the number of responses on each alternative, a possible explanation could be that earlier sessions had VI-VI combinations that affected their choice of alternatives. Based on their results it can be interpreted that the order of the VI-VI schedules could have some impact on their response behavior. It can be argued that it makes the participants biased in the choice making process. A theory to increase the number of responses on the richer alternative is to increase the reinforcement frequency in one VI schedule for each session (Baum and Davison, 2000). In other words, it is recommended to take into account the effects of concurrent schedules set up regarding VI-VI schedules combination and order future experiments. It is of importance to remember that poor discrimination between the alternatives could result in low response rate differences between the options in a concurrent schedule Baum (1974a). The effects of concurrent schedules set up regarding VI-VI schedules combination and order. Another factor that may have impacted the results, and which future experimentation can evaluate, is the duration of sessions. In this present study

the participants only had 35 minutes on each VI-VI schedule, which was half of what they had in the Dale (2021) experiment, which lasted for 70 minutes. In other words, longer sessions can lead to more stability. The reason for not having the same duration as earlier study is because of the choice of participant group. Longer sessions were not an option due to their school schedule. The participant group also had a less complex experimental setting compared to Dale's (2021) experimental setup, which had two computers with a set of keyboards each and a 1,8 m tall wall to separate the participants. In this present experiment, only one PC with a keyboard was used, as seen in Figure 2. The reason for the setup was to simplify the execution of the experiment due to limited time. The reduction in equipment use made it easier to execute the experiment. However, in further research, a wall is recommended between the participants and two keyboards. To achieve more experimental control, a replica of Dale (2021) is recommended. Installing a wall between the participants was meant to assure that students would not communicate. Despite the fact that they were told not to communicate, it was observed attempts of communication between the participants, both by whispering, and non-verbally by pointing to suggestions for placement to the other player. These attempts were quickly spotted and the participants were reminded to not communicate and share strategies.

Using concurrent schedules of reinforcement to understand choice behavior is of importance because it makes the individual allocate their behavior to archive reinforcement, which in a non-experimental situation can be, for example, to change one behavior to another behavior that achieves a particular goal. Study findings of choice behavior have produced predictions of the behavior of organisms in the form of understanding how the individuals' responses are connected to reinforcement. Herrnstein (1961) introduced The theory of Matching Law that explained how animals and humans allocate their behavior to archive reinforcement. This phenomenon is studied through an experiment on pigeons pecking on

two different keys one with a richer reinforcement alternative. Results from this study showed that the relative rate of reinforcement matched the relative rate of reinforcement. Later Baum (1074b) studied this phenomenon and presented a modified version of the Matching Law called the Generalized Matching Law (GML). This version included parameters that took into account sensitivity and bias effects. By applying GML to interpret coordinated behavior of pairs of children playing a computer game with two placement options, we can provide some insight to understand what conditions we need to apply in order to increase one type of response, or reduce one type for response. Study findings like these can be a contribution to research regarding increasing appropriate behavior and decreasing inappropriate behavior. By performing this experiment with children in elementary school, more knowledge about choice behavior and coordinated behavior of children in groups can be implemented. Furthermore, it will also contribute to generalization and give room to increase the validity of earlier research findings. Results and findings may also contribute to new findings that can support earlier and new studies of the Matching Law and choice behavior. New findings may also be beneficial to studies regarding methods on how to increase responses from children to achieve effective learning and reduce inappropriate and antisocial behavior in classroom settings. The goal of this study was to present new results, analyze data, and examine how new data corresponds to results from earlier studies of cooperative responding under concurrent schedules of reinforcement (Carvalho et al. 2016; Dale, 2021; Todorov & Vasconcelos, 2015).

Earlier studies by Herrnstein (1961) and Baum (1974b; 1979) have contributed theories to understand how organisms make choices, more specifically how they allocate their behavior when they are presented with two choices. Their studies have shown that the organisms often allocate their response to the richer alternative. From that, we learn that not only can organisms allocate their behavior when presented with more reinforcement, but also

that we can control behavior by allocating where we choose to distribute reinforcement. By studying this phenomenon and presenting more results of choice behavioral control, we can gain an understanding of what determines choice and increase the probability of prediction, and how the organism responds in different contexts where there is control of reinforcer variables.

It is important to highlight that studies pertaining to humans can be more complex than studies of animals. Coordinated responses within human subjects can be affected by other factors, such as social interventions. Even though communication was not allowed in this present study and there were no planned reports on observation findings of the participants behavior, it is important to point out that their interaction may have influenced their choice when it was their turn to place the pieces. Newer studies regarding cultural selection have been done under laboratory research where variables are controlled in the experiments. In cultural selection research it has been scientifically proven that individuals adapt their behavior to the environment and in relation to other individuals in the specific environment the organism is in. This is to achieve success, benefit, or advantage, which is a pleasant reinforcement. For example, if it is beneficial to work together to place the piece in the game on the right, even if the organism itself wants to respond on the left, he chooses to place the piece on the right with the other player because he knows that placing the piece on the right with the other player gives points. In this context, cultural selection arises in that person 1 changes his behavior in a way that correlates with person 2, because he has learned that cooperating and placing the pieces together in the same area gives points, in this case points are received when both players place the pieces in the right field.

By not excluding the effects of social intervention, we can gain a more consistent understanding of choice behavior and what affects choice in humans. One might argue that excluding the social environment effect simplifies behaviors to a complex phenomena. In this

present study the possible social environmental effect is that the children attended the same class, which might have had an effect on how they placed their pieces, since there were no walls between the participants and there were possibilities of verbal and non-verbal communication.

By presenting more results of choice behavioral control we can gain an understanding on what determines choice and increase the probability of prediction of how the organism responds in different contexts where there is control of reinforcer variables.

Conclusion

According to the data analysis, the present study did not have results that corroborated with results from Carvalho et al. (2016), Dale, 2021 and Todorov & Vasconcelos (2015) research. However, results from this experiment should not be used to contradict theories and results from previously performed experiments on concurrent schedules and completely reject the validity of the Generalized Matching Law theory. This present study should instead be viewed as a contribution to how certain conditions should be obtained in order to achieve cooperative behavior. These findings are of importance for future researchers with the aim of validating evidence of the Matching Law and generalizing findings confirming the correlation between cooperative responding and reinforcement in earlier studies.

One important outcome of this present study is the findings that highlight the importance of conditions in earlier studies in order to archive prediction of choice behavior. Conditions like stabilization rounds, longer duration of sessions, more experiment days, and upgrading of timevalue in a VI schedule for each session is a procedural requirement to achieve results obtained in previous experiments when it comes to predicting choice behavior. Results from this present study can instead be used as a proposal for conditions to

achieve better results in studies regarding cooperative responding in children and other subjects of choice.

Gaining an understanding of cooperative behavior and concurrent schedules within children can be of great value in light of its contribution to further research regarding maximizing behavioral change and effectiveness of child behavior in classroom settings.

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Tables

Table 1

Data of the individual response pattern of each pairs

Pair	Schedule of reinforcement	Sessions	Participant 1		Participant 2		Response rate		Log transformation	
			Left	Right	Left	Right	Participant 1	Participant 2	P1 LOG	P2 LOG
AB	VI 10s -VI 10s	1	49	33	36	59	0,67	1,64	-0,17	0,21
		2	103	44	38	107	0,43	2,82	-0,37	0,45
		3	17	20	18	17	1,18	0,94	0,07	-0,02
		4	16	28	27	11	1,75	0,41	0,24	-0,39
		5	12	23	17	14	1,92	0,82	0,28	-0,08
	VI 40s -VI 10s	1	10	30	24	12	3,00	0,50	0,48	-0,30
		2	10	30	22	15	3,00	0,68	0,48	-0,17
		3	17	22	18	19	1,29	1,06	0,11	0,02
		4	15	15	12	24	1,00	2,00	0,00	0,30
		5	18	17	10	20	0,94	2,00	-0,02	0,30
	VI 20s - VI 10s	1	6	20	12	12	3,33	1,00	0,52	0,00
		2	13	14	7	26	1,08	3,71	0,03	0,57
		3	13	13	5	24	1,00	4,80	0,00	0,68
		4	15	21	17	21	1,40	1,24	0,15	0,09
		5	91	43	42	98	0,47	2,33	-0,33	0,37
	VI 10s - VI 20s	1	17	23	16	16	1,35	1,00	0,13	0,00
		2	22	20	12	18	0,91	1,50	-0,04	0,18
		3	18	15	18	25	0,68	1,39	-0,17	0,14
		4	14	15	13	11	1,07	0,85	0,03	-0,07
		5	29	22	24	31	0,76	1,29	-0,12	0,11
	VI 10s - VI 40s	1	15	15	18	7	1,00	0,39	0,00	-0,41
		2	20	1	12	1	0,05	0,08	-1,30	-1,08
		3	17	1	17	1	0,06	0,06	-1,23	-1,23
		4	17	2	18	1	0,12	0,06	-0,93	-1,26
		5	15	1	21	1	0,07	0,05	-1,18	-1,32
CD	VI 10s - VI 40s	1	53	36	39	52	0,68	1,33	-0,17	0,12
		2	34	29	37	37	0,85	1,00	-0,07	0,00
		3	60	42	46	55	0,70	1,20	-0,15	0,08
		4	57	33	39	61	0,58	1,56	-0,24	0,19
		5	89	45	43	84	0,51	1,95	-0,30	0,29
	VI 20s - VI 10s	1	39	30	22	35	0,77	1,59	-0,11	0,20
		2	40	22	24	43	0,55	1,79	-0,26	0,25
		3	19	23	14	28	1,21	2,00	0,08	0,30
		4	3	12	3	22	4,00	7,33	0,60	0,87
		5	2	19	1	16	9,50	16,00	0,98	1,20
	VI 40s -VI 10s	1	4	16	4	15	4,00	3,75	0,60	0,57
		2	4	18	10	17	4,50	1,70	0,65	0,23

EF	VI 10s - VI10s	1	44	51	8	15	1,16	1,88	0,06	0,27
		2	75	72	13	11	0,96	0,85	-0,02	-0,07
		3	58	61	11	13	1,05	1,18	0,02	0,07
		4	59	64	9	14	1,08	1,56	0,04	0,19
		5	57	57	12	13	1,00	1,08	0,00	0,03
	VI 10s - VI 20s	1	50	43	15	8	0,92	0,53	-0,07	-0,27
		2	36	30	12	7	0,83	0,58	-0,08	-0,23
		3	41	42	11	11	1,02	1,00	0,01	0,00
		4	43	33	16	5	0,77	0,31	-0,11	-0,51
		5	50	49	12	10	0,98	0,83	-0,01	-0,08
	VI 10- VI 40s	1	51	47	8	5	0,91	0,63	-0,04	-0,20
		2	57	49	14	5	0,86	0,36	-0,07	-0,45
		3	131	131	6	6	1,00	1,00	0,00	0,00
		4	118	118	7	7	1,00	1,00	0,00	0,00
		5	44	40	9	5	0,91	0,56	-0,04	-0,26
	VI 40s - VI 10s	1	34	42	8	16	1,24	2,00	0,09	0,30
		2	43	52	6	14	1,21	2,33	0,08	0,37
		3	41	49	5	13	1,20	2,60	0,08	0,41
		4	43	53	7	16	1,23	2,29	0,09	0,36
		5	40	46	7	14	1,15	2,00	0,06	0,30
	VI 20s - VI10s	1	36	39	10	13	1,08	1,30	0,03	0,11
		2	34	46	6	19	1,35	3,17	0,13	0,50
		3	38	49	7	17	1,29	2,43	0,11	0,39
		4	35	35	12	12	1,00	1,00	0,00	0,00
		5	36	39	11	14	1,08	1,27	0,03	0,10
GH	VI 10s - VI 10s	1	63	63	9	9	1,00	1,00	0,00	0,00

		3	1	19	1	19	19,00	19,00	1,28	1,28
		4	1	16	1	18	16,00	18,00	1,20	1,26
		5	2	17	1	17	8,50	17,00	0,93	1,23
	VI10s - VI10s	1	5	22	6	20	4,40	3,33	0,64	0,52
		2	3	14	1	23	4,67	23,00	0,67	1,36
		3	6	11	2	16	1,83	8,00	0,26	0,90
		4	1	16	1	20	16,00	20,00	1,20	1,30
		5	4	18	1	16	4,50	16,00	0,65	1,20
	VI 10s - VI 20s	1	1	13	1	11	13,00	11,00	1,11	1,04
		2	1	7	1	12	7,00	12,00	0,85	1,08
		3	1	11	1	10	11,00	10,00	1,04	1,00
		4	7	11	2	12	1,57	6,00	0,20	0,78
		5	1	9	1	11	9,00	11,00	0,95	1,04
EF	VI 10s - VI10s	1	15	32	29	19	2,13	0,66	0,33	-0,18
		2	19	52	56	20	2,74	0,36	0,44	-0,45
		3	31	28	27	33	0,90	1,22	-0,04	0,09
		4	39	13	20	13	0,33	0,65	-0,48	-0,19
		5	32	22	25	35	0,69	1,40	-0,16	0,15
	VI 10s - VI 20s	1	22	17	28	26	0,77	0,93	-0,11	-0,03
		2	15	15	21	15	1,00	0,71	0,00	-0,15
		3	25	13	16	29	0,52	1,81	-0,28	0,26
		4	21	14	22	19	0,67	0,86	-0,18	-0,06
		5	23	23	27	26	1,00	0,96	0,00	-0,02
	VI 10- VI 40s	1	25	23	26	24	0,92	0,92	-0,04	-0,03
		2	21	28	36	21	1,33	0,58	0,12	-0,23
		3	77	58	54	73	0,75	1,35	-0,12	0,13
		4	79	39	39	79	0,49	2,03	-0,31	0,31
		5	26	13	18	27	0,50	1,50	-0,30	0,18
	VI 40s - VI 10s	1	17	25	17	17	1,47	1,00	0,17	0,00
		2	25	21	18	31	0,84	1,72	-0,08	0,24
		3	25	17	16	32	0,68	2,00	-0,17	0,30
		4	22	27	21	26	1,23	1,24	0,09	0,09
		5	16	23	24	23	1,44	0,96	0,16	-0,02
	VI 20s - VI10s	1	11	24	25	15	2,18	0,60	0,34	-0,22
		2	14	20	20	26	1,43	1,30	0,15	0,11
		3	18	22	20	27	1,22	1,35	0,09	0,13
		4	18	14	17	21	0,78	1,24	-0,11	0,09
		5	23	18	13	21	0,78	1,62	-0,11	0,21
GH	VI 10s - VI 10s	1	42	24	21	39	0,57	1,86	-0,24	0,27

	2	18	21	21	17	1,17	0,81	0,07	-0,09
	3	14	14	20	13	1,00	0,65	0,00	-0,19
	4	14	19	25	16	1,36	0,64	0,13	-0,19
	5	14	17	11	19	1,21	1,73	0,08	0,24
VI 10s -VI 20s	1	18	17	23	19	0,94	0,83	-0,02	-0,08
	2	12	21	20	5	1,75	0,25	0,24	-0,60
	3	15	12	18	11	0,80	0,61	-0,10	-0,21
	4	13	11	7	12	0,85	1,71	-0,07	0,23
	5	14	13	15	20	0,93	1,33	-0,03	0,12
VI 40s - VI 10s	1	15	24	16	16	1,60	1,00	0,20	0,00
	2	13	21	17	15	1,62	0,88	0,21	-0,05
	3	15	15	11	14	1,00	1,27	0,00	0,10
	4	5	30	19	9	6,00	0,47	0,78	-0,32
	5	17	16	9	22	0,94	2,44	-0,03	0,39
VI 20s - VI 10s	1	11	18	12	14	1,64	1,17	0,21	0,07
	2	6	18	10	14	3,00	1,40	0,48	0,15
	3	11	10	7	15	0,91	2,14	-0,04	0,33
	4	14	25	19	17	1,79	0,89	0,25	-0,05
	5	9	20	9	17	2,22	1,89	0,35	0,28
VI 10s - VI 40s	1	14	9	12	15	0,64	1,25	-0,19	0,10
	2	11	20	20	9	1,82	0,45	0,26	-0,35
	3	7	21	21	8	3,00	0,38	0,48	-0,42
	4	16	20	24	11	1,25	0,46	0,10	-0,34
	5	16	21	19	12	1,31	0,63	0,12	-0,20

Note. Overview of the data collection of participants pairs AB, CD, EF and GH. Response pattern for each pair of participants is illustrated in this figure. All pairs went through variable interval form with the values VI 10s-VI 10s, VI 10s-VI 40s, VI 10s - VI 60s, VI 60s - VI 10s and VI 40s - VI 10s. As shown in the table, the order was different. R right shows how many times the participants placed their pieces in the right square and R left shows how many times the participants placed their pieces in the left square.The numbers marked in red highlight when participants have placed the pieces more on VI forms with a higher time-second value than VI forms with a lower time-second value. Another important note is that S + left had to be 1 or <1 for the calculation to be possible without error on excel. Therefore the data that had a value below 1 was corrected to 1.

Table 2

Log transformation data of pair AB, CD, EF and GH

Pairs of participants	VI schedule of reinforcement	Session	Response		Reinforcement		Response rate	S+ rate	Log transformation	
			R left	R right	S + Left	S+ Right			Log R	Log S+
AB	VI 10s -VI 10s	1	85	92	7	14	1,08	2,00	0,03	0,30
		2	141	151	3	13	1,07	4,33	0,03	0,64
		3	35	37	11	14	1,06	1,27	0,02	0,10
		4	43	39	15	12	0,91	0,80	-0,04	-0,10
		5	29	37	7	15	1,28	2,14	0,11	0,33
	VI 40s -VI 10s	1	34	42	7	15	1,24	2,14	0,09	0,33
		2	32	45	6	18	1,41	3,00	0,15	0,48
		3	35	41	6	13	1,17	2,17	0,07	0,34
		4	27	39	5	16	1,44	3,20	0,16	0,51
		5	28	37	5	15	1,32	3,00	0,12	0,48
	VI 20s - VI 10s	1	18	32	5	19	1,78	3,80	0,25	0,58
		2	20	40	2	23	2,00	11,50	0,30	1,06
		3	18	37	4	24	2,06	6,00	0,31	0,78
		4	32	42	6	17	1,31	2,83	0,12	0,45
		5	133	141	2	10	1,06	5,00	0,03	0,70
	VI 10s - VI 20s	1	33	39	7	8	1,18	1,14	0,07	0,06
		2	34	38	6	11	1,12	1,83	0,05	0,26
		3	36	40	6	11	1,11	1,83	0,05	0,26
		4	27	26	9	8	0,96	0,89	-0,02	-0,05
		5	53	53	7	8	1,00	1,14	0,00	0,06
	VI 10s - VI 40s	1	33	22	13	2	0,67	0,15	-0,18	-0,81
		2	31	1	30	1	0,03	0,03	-1,49	-1,48
		3	33	1	32	1	0,03	0,03	-1,52	-1,51
		4	35	2	33	1	0,06	0,03	-1,24	-1,52
		5	34	1	33	1	0,03	0,03	-1,53	-1,52
CD	VI 10s - VI 40s	1	92	88	11	6	1,0	0,5	-0,02	-0,26
		2	71	66	9	5	0,9	0,6	-0,03	-0,26
		3	106	97	13	5	0,9	0,4	-0,04	-0,41
		4	96	94	9	7	1,0	0,8	-0,01	-0,11
		5	132	129	6	3	1,0	0,5	-0,01	-0,30
	VI 20s - VI 10s	1	61	65	9	14	1,1	1,6	0,03	0,19
		2	64	65	8	10	1,0	1,3	0,01	0,10
		3	33	51	7	24	1,5	3,4	0,19	0,54
		4	6	34	1	27	5,7	27,0	0,75	1,43
		5	2	35	1	32	17,5	32,0	1,24	1,51
	VI 40s -VI 10s	1	8	31	2	25	3,9	12,5	0,59	1,10
		2	14	35	4	25	2,5	6,3	0,40	0,80
		3	1	36	1	34	36,0	34,0	1,56	1,53
		4	1	33	1	33	33,0	33,0	1,52	1,52
		5	2	33	1	31	16,5	31,0	1,22	1,49
	VI10s - VI10s	1	11	42	2	32	3,8	16,0	0,58	1,20
		2	3	36	1	33	12,0	33,0	1,08	1,52
		3	8	27	5	24	3,4	4,8	0,53	0,68
		4	1	35	1	34	35,0	34,0	1,54	1,53
		5	4	33	1	29	8,3	29,0	0,92	1,46
	VI 10s - VI 20s	1	1	23	1	21	23,0	21,0	1,36	1,32
		2	1	17	1	17	17,0	17,0	1,23	1,23
		3	1	19	1	19	19,0	19,0	1,28	1,28
		4	9	23	1	14	2,6	14,0	0,41	1,15
		5	1	19	1	18	19,0	18,0	1,28	1,26

EF	VI 10s - VI10s	1	44	51	8	15	1,16	1,88	0,06	0,27
		2	75	72	13	11	0,96	0,85	-0,02	-0,07
		3	58	61	11	13	1,05	1,18	0,02	0,07
		4	59	64	9	14	1,08	1,56	0,04	0,19
		5	57	57	12	13	1,00	1,08	0,00	0,03
	VI 10s - VI 20s	1	50	43	15	8	0,92	0,53	-0,07	-0,27
		2	36	30	12	7	0,83	0,58	-0,08	-0,23
		3	41	42	11	11	1,02	1,00	0,01	0,00
		4	43	33	16	5	0,77	0,31	-0,11	-0,51
		5	50	49	12	10	0,98	0,83	-0,01	-0,08
	VI 10- VI 40s	1	51	47	8	5	0,91	0,63	-0,04	-0,20
		2	57	49	14	5	0,86	0,36	-0,07	-0,45
		3	131	131	6	6	1,00	1,00	0,00	0,00
		4	118	118	7	7	1,00	1,00	0,00	0,00
		5	44	40	9	5	0,91	0,56	-0,04	-0,26
	VI 40s - VI 10s	1	34	42	8	16	1,24	2,00	0,09	0,30
		2	43	52	6	14	1,21	2,33	0,08	0,37
		3	41	49	5	13	1,20	2,60	0,08	0,41
		4	43	53	7	16	1,23	2,29	0,09	0,36
		5	40	46	7	14	1,15	2,00	0,06	0,30
	VI 20s - VI10s	1	36	39	10	13	1,08	1,30	0,03	0,11
		2	34	46	6	19	1,35	3,17	0,13	0,50
		3	38	49	7	17	1,29	2,43	0,11	0,39
		4	35	35	12	12	1,00	1,00	0,00	0,00
		5	36	39	11	14	1,08	1,27	0,03	0,10
GH	VI 10s - VI 10s	1	63	63	9	9	1,00	1,00	0,00	0,00
		2	39	38	15	14	0,97	0,93	-0,01	-0,03
		3	34	27	18	11	0,79	0,61	-0,10	-0,21
		4	39	35	14	9	0,90	0,64	-0,05	-0,19
		5	25	36	11	21	1,44	1,91	0,16	0,28
	VI 10s -VI 20s	1	41	36	14	9	0,88	0,64	-0,06	-0,19
		2	32	26	13	8	0,81	0,62	-0,09	-0,21
		3	33	23	16	7	0,70	0,44	-0,16	-0,36
		4	20	23	6	9	1,15	1,50	0,06	0,18
		5	29	33	6	9	1,14	1,50	0,06	0,18
	VI 40s - VI 10s	1	31	40	4	14	1,29	3,50	0,11	0,54
		2	30	36	7	14	1,20	2,00	0,08	0,30
		3	26	29	8	12	1,12	1,50	0,05	0,18
		4	24	39	4	19	1,63	4,75	0,21	0,68
		5	26	38	3	15	1,46	5,00	0,16	0,70
	VI 20s - VI 10s	1	23	32	1	20	1,39	20,00	0,14	1,30
		2	16	32	3	19	2,00	6,33	0,30	0,80
		3	18	25	7	15	1,39	2,14	0,14	0,33
		4	33	42	7	16	1,27	2,29	0,10	0,36
		5	18	37	1	20	2,06	20,00	0,31	1,30
	VI 10s - VI 40s	1	26	24	7	5	0,92	0,71	-0,03	-0,15
		2	31	29	9	7	0,94	0,78	-0,03	-0,11
		3	28	29	7	8	1,04	1,14	0,02	0,06
		4	40	31	12	4	0,78	0,33	-0,11	-0,48
		5	35	33	10	8	0,94	0,80	-0,03	-0,10

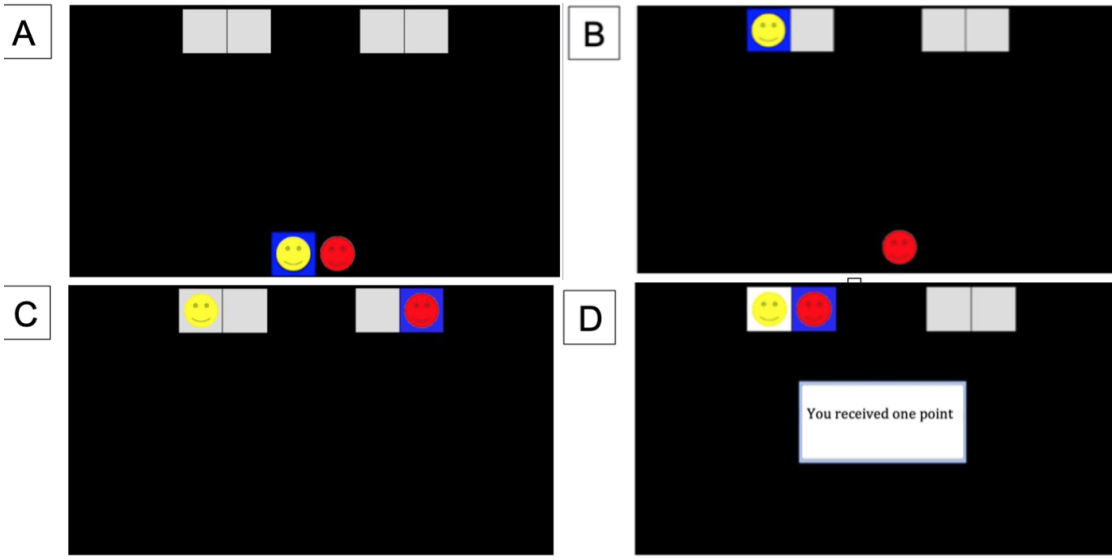
Note. The numbers marked in red are the responses allocated in the non-richer alternative in the concurrent VI-schedule of reinforcement.

**A specific note* is referred to the last five sessions, the pair CD distributed their responses mostly on the right side of the board which was the alternative in the concurrent VI-VI schedule with the least frequent reinforcement.

Figures

Figure 1

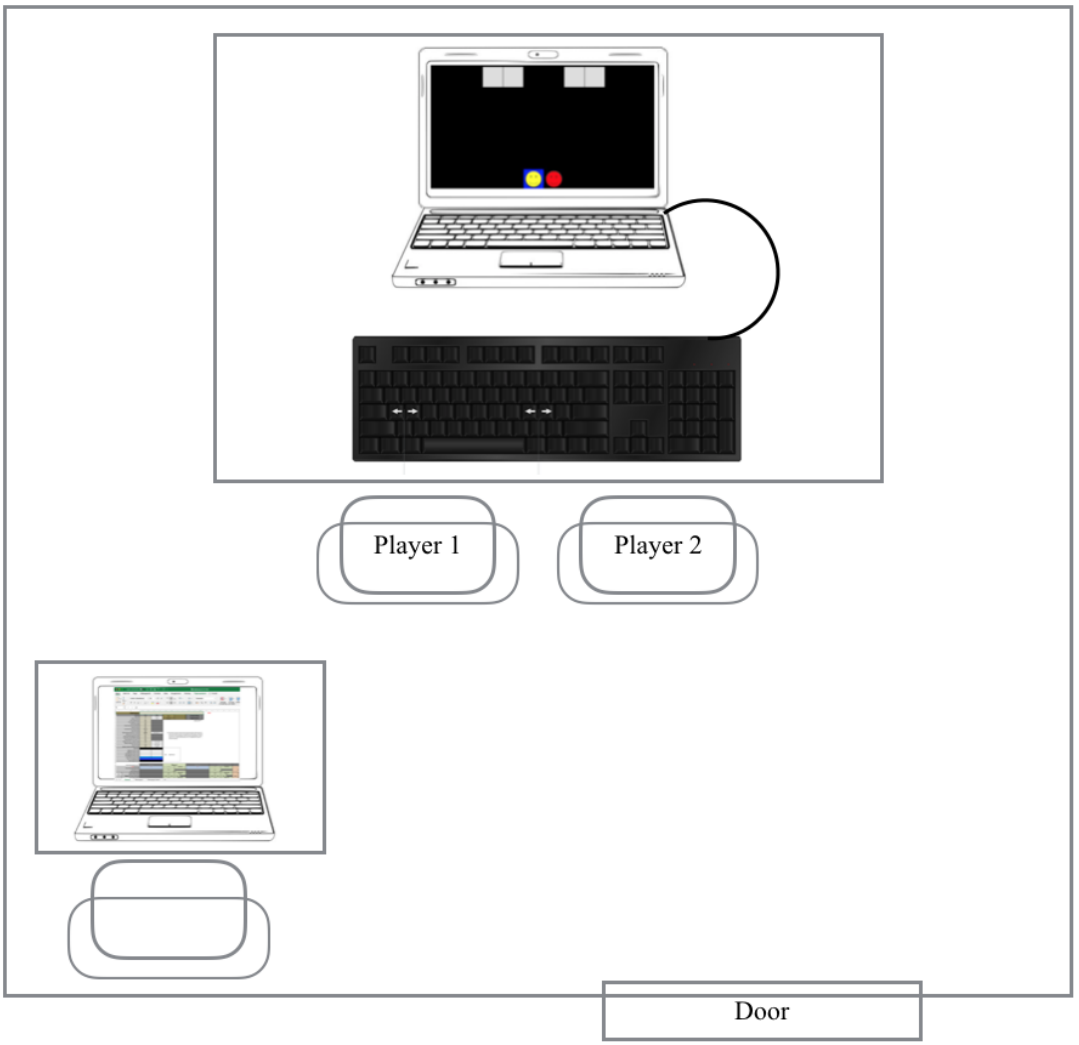
Illustration of the gaming software Xadrez version 2.11.13



Note. An illustration of the gaming software Xadrez version 2.11.13. Picture A shows the players starting point. Each player controls a smiley - one participant plays the yellow smiley and the other participant plays the red smiley. The two gray squares in the top of the screen is where the players can place their playing pieces. The blue square indicated whose turn it was to play. Picture B and C illustrates how the playing pieces can move around on the board. The player can choose to either place their piece in the right square by pressing the right key or the left square by pressing the left key on the keyboard. The players are informed beforehand that placing the pieces next to each other increases their chances to receive a point. However they will not earn a point every time they place the pieces together. Either way the pieces will be reseted to where they started when they are placed next to each other. When a point is received a message will appear on the board, as seen in picture D. Compared to the earlier software Xandrex version 2.11.12, this version has a different message when a point is received. In this version when a point is earned the pair will have the message “You received one point” pop up on the screen.

Figure 2

Illustration of the experiment setup



Note. Experiment room was a study room at Veitvet skole. The room consisted of a large table, two chairs and a laptop with a keyboard connected. The participants were placed against the PC screen with the keyboard in front of them. The experimenter was placed behind the participants with a table, chair and a laptop. After each session (every seven minutes), the experimenter turned the laptop away from the participants and started a new session. Participants did not have insight into the data that was collected during the experiment.

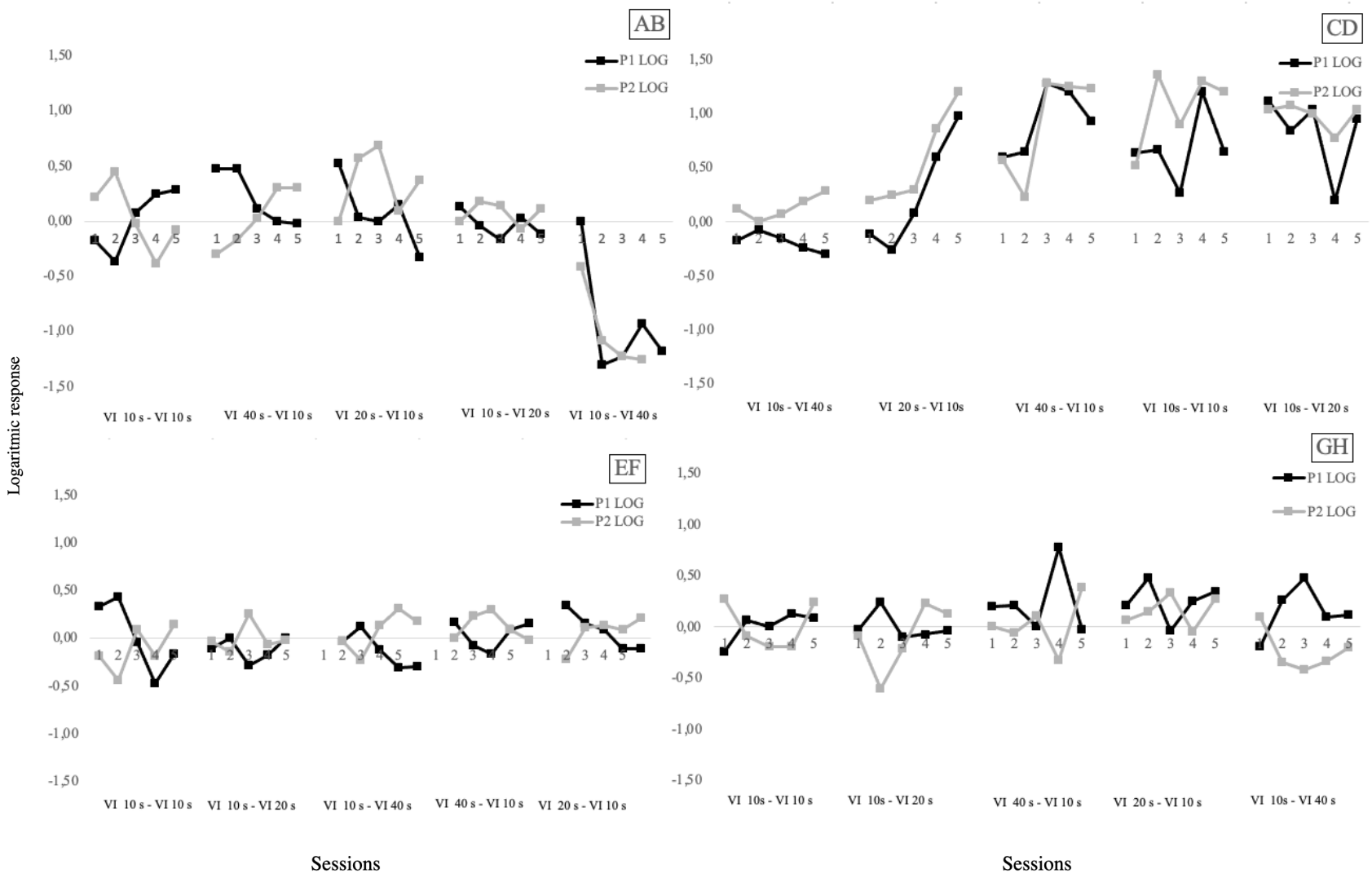
Figure 3

Gaming keyboard

Note. The gaming keyboard had four markings in total; the arrows on the right side belonged to the yellow piece and the left side belonged to the red piece. Both had an arrow pointing to the right and another to the left. These were used to place the pieces on the board. The rest of the keyboards were removed from the keyboard to prevent typing error.

Figure 4

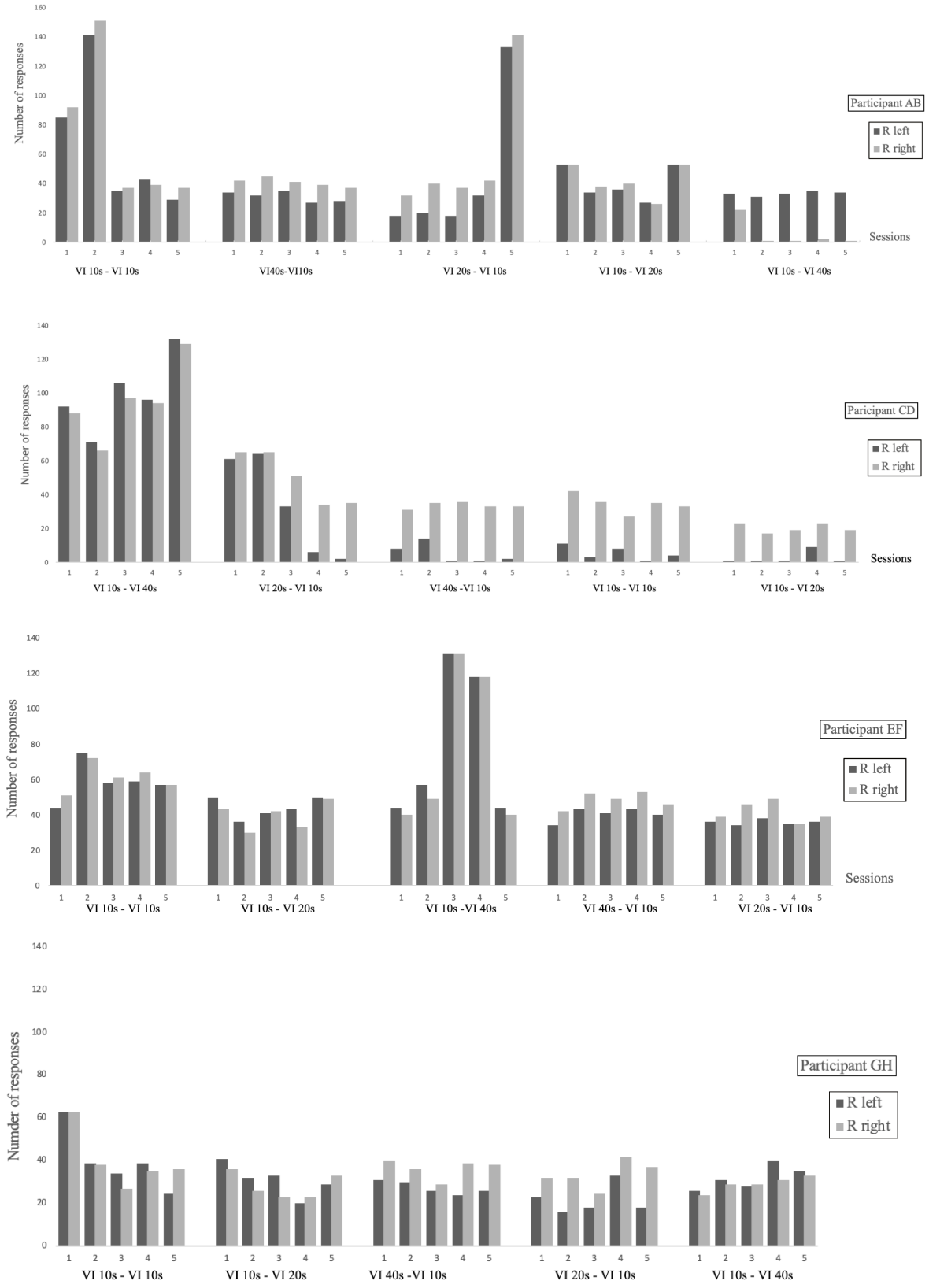
Log transformation data of the pairs individual response ratio



Note. The y-axis shows the number of logarithmic responses, and the x-axis shows sessions. The gray line represents the log of responsrate in participant 1 and the black line represents participant 2. The placement of the line shows where the participants responded on the board. Values above zero represent responses on the left side. Values below zero represent responses on the right side.

Figure 5

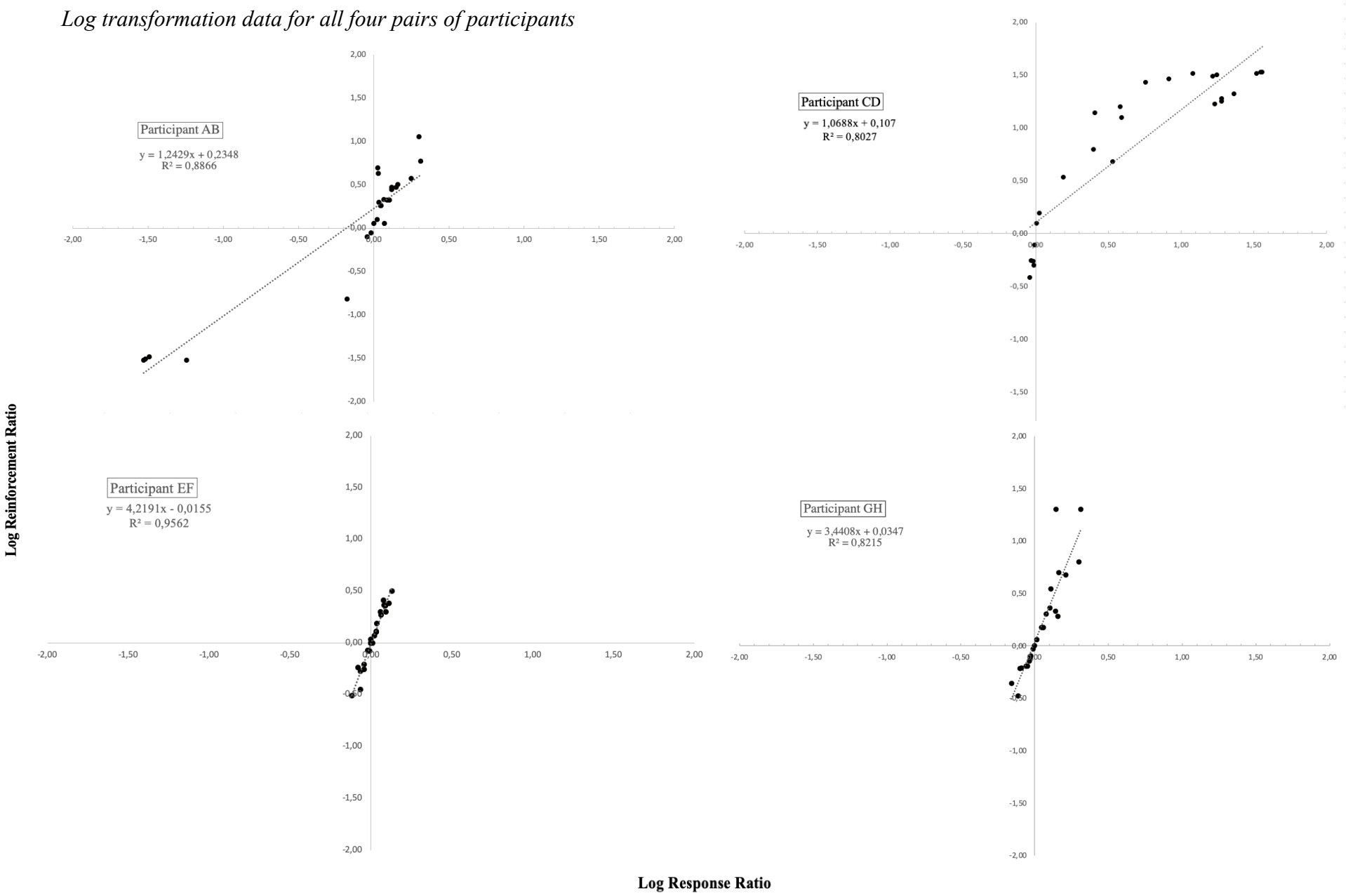
Number of responses under different VI-VI schedules of reinforcement



Note. Diagram is based on data from Table 1, and illustrates the pair's response behavior. The bar graph shows the number of times the players have placed their pieces together. In the game, they can choose between the gray squares, one on the left side with space for two pieces and the right side with space for two pieces. When players place their piece together on the left field, the response is entered on the R left (dark gray line). If the players place their pieces on the right field, the response is entered on R right (light gray line). The bar graph shows how the pairs responded in each session.

Figure 6

Log transformation data for all four pairs of participants



Note. Log transformation data for all four pairs of participants AB, CD, EF and GH. Diagram is created based on data from Table 1. The log transformation ratio is made by plotting log response ratio against log reinforcement ratio. The Y-axis represents log transformation of the reinforcement ratio. X-axis is the log transformation of the response ratio. Pairs went through 5 experimental days, 5 sessions on each day equals 25 sessions in total. The black squares in the diagram represent sessions. The equation represents the sensitivity value and bias value, which illustrates if the participants were biased to one ofte alternatives. R^2 represents the correlation value, which represents the participants response rate compared to each other in the group.

Appendixes

Appendix 1

Information letter about the research project. Instructions were given in Norwegian.

Informasjon om forskningsprosjektet til foresatte

I februar og mars måneden er det planlagt gjennomføring av et forskningsprosjekt som tar for seg tema: atferd hos barn i gruppesammensetninger. Formålet med studiet er å undersøke hvordan elever koordinerer sin respons i samarbeid med andre elever.

Det vil bli utført en eksperimentell atferdsanalyse, hvor elever først blir delt opp i par og deretter skal løse en oppgave gjennom å spille et dataspill sammen. Deltakelse i forskningsprosjektet bidrar til at vi får utvide teoretisk og eksperimentell kunnskap om barns atferd i grupper.

Studiet er et forskningsprosjekt som utføres som en del av masteroppgaven (vår 2022) ved fakultet for helsevitenskap avd. atferdsvitenskap ved Oslo Metropolitan University (OsloMet).

Forskningsprosjektet er godkjent for iverksetting av Norsk senter for forskningsdata (NSD) og utføres i samarbeid med Veitvet skole.

Elever er velkommen til å delta. De som ønsker å delta kan melde seg inn ved å gi beskjed muntlig eller skriftlig via teams melding til skoleassistent Fatemeh Bozorgian eller kontaktlærer. For å kunne delta i forskningsprosjektet må det innleveres et samtykkeskjema, som må være underskrevet av foresatte. Det kan også gis tillatelse for deltakelse via muntlig samtykke fra foresatte
Lokasjon. Studiet utføres på Veitvet skole. **Aktuelle kandidater.** Elever fra 5.-6.trinn.
Hva innebærer det å være deltaker i prosjektet. Som deltaker i forskningsprosjektet vil du sammen med en annen elev fra samme trinn spille et dataspill hvor formålet er at dere skal oppnå mest poeng. Spillet er designet med brikker som spillerne må plassere i bestemte ruter for å oppnå poeng. Det vil være en assistent tilstede under hele økten.

Prosjektets varighet. Elever som blir valgt som deltaker vil bli tatt ut i 35 min fra ordinær time seks ganger i løpet av februar og mars måneden.

Hva skjer med resultatene? Resultater fra studiet, inkludert all innsamlet data, vil bli publisert i en masteroppgave og kan bli lagt inn i OsloMet sin database, som senere kan henvises til i tidsskrifter eller mulige profesjonelle presentasjoner, men navnet ditt eller identifiserbare referanser om deg vil ikke bli inkludert. Datamaterialet vil lagres på passordbeskyttet forskningsserver. Alle deltakere har rett til innsyn til sitt resultat hvis de ønsker dette.

Konfidensialitet og personvern. Vi behandler opplysningene konfidensielt og i samsvar med personvernregelverket. Dataene som genereres i eksperimentet blir ikke identifisert med navn, vi gir eleven en navnekode for å identifisere eksperimentelle data. Vi behandler opplysninger om deltakerens resultater på bakgrunn av forskning prosjektets formål, som er vurdert å være i allmennhetens interesse. NSD – Norsk senter for forskningsdata AS vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

Frivillig deltakelse. Det er frivillig å delta i forskningsprosjektet. Det betyr at du som deltaker når som helst og uten grunn kan trekke ditt samtykke til å delta i forskningsprosjektet. Alle dine personopplysninger vil da bli slettet. Det vil ikke ha noen negative konsekvenser for deg hvis du velger å trekke deg.
Hva skjer med opplysningene dine når vi avslutter forskningsprosjektet?
Opplysningene anonymiseres når prosjektet avsluttes/oppgaven er godkjent, noe som etter planen er 15.juni 2022.

Dine rettigheter
Så lenge du kan identifiers i datamaterialet, har du rett til:

- å protestere
- innsyn i hvilke personopplysninger som er registrert om deg
- å få rettet personopplysninger om deg,
- å få slettet personopplysninger om deg, og
- å sende klage til Datatilsynet om behandlingen av dine personopplysninger.

Hvis du har spørsmål til studien, eller ønsker å vite mer eller å benytte deg av dine rettigheter, ta kontakt med:

- Prosjektansvarlig *Fatemeh Bozorgian, ass. på Veitvet skole og masterstudent på fakultet for helsevitenskap, avd. Atferdsvitenskap.* E-post. s306504@oslomet.no eller tlf. 47 23 55 80.
- Prosjektveileder Kalliu Carvalho Couto, PhD. Research fellow og veileder. E-post. kcouto@oslomet.no.

Hvis du har spørsmål knyttet til NSD sin vurdering av prosjektet, kan du ta kontakt med: NSD – Norsk senter for forskningsdata AS på epost (personverntjenester@nsd.no) eller på telefon: 53 21 15 00.

Med vennlig hilsen

Kalliu Carvalho Couto
Postdoktor og veileder ved OsloMet
E-post: kcouto@oslomet.no

Fatemeh Bozorgian
Prosjektansvarlig og masterstudent ved
E-post. s306504@oslomet.no

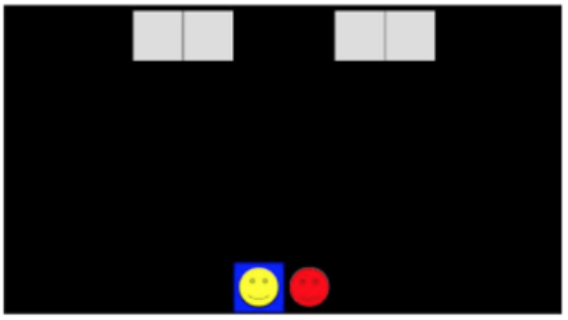
Appendix 2

Project information and consent form for participation written in Norwegian.

Vil du være med på et forskningsprosjekt?

Elever fra 5.-6.klasse ønskes som deltakere

I februar og mars måneden vil det utføres et forskningsprosjekt i samarbeid med OsloMet og Veitvet skole. Formålet med forskningsprosjektet er å lære mer om hvordan elever jobber sammen i grupper. Deltakelse i forskningsprosjektet innebærer at du sammen med en annen mendeleev spiller et dataspill, der målet er å oppnå mest poengsum. Det vil bli gjort en atferdsanalyse av resultatet du får i spillet.



Deltakelse i forskningsprosjektet vil være et godt bidrag til å utvide teoretisk og eksperimentell kunnskap om barns atferd i grupper og for forskning som omhandler å effektivisere læring blant elever på skolen.

Som deltaker vil du spillet et dataspill sammen med en annen elev 6 ganger i løpet av februar og mars måneden. Hver gang har en spillrunde på 35 minutter.
Vi håper du vil sette av litt tid til dette samarbeidet. Vi har foreløpig plass til seks deltakere.

Med vennlig hilsen
Fatemeh Bozorgian
Ass. på Veitvet skole
Prosjektansvarlig

Samtykkeskjema

Elevens navn:_____ Trinn: _____

Jeg bekrefter at jeg har lest og forstått hva eksperimentet innebærer.

Foresattes underskrift: _____Dato:_____

Appendix 3

Game instruction translated from norwegian to english

Introduction
You will play as a playing piece in this game - the player to the left is the yellow player and the player to the right is the red player. The goal of the game is to make as many points as possible. To earn points you have to meet the other player in one of the two marked gray areas on the board, one on the left and one on the right side.

A meeting is achieved when both of your playing pieces are placed in squares next to each other.
Controls:

- ★ Start the game by pressing any key on the keyboard.
- ★ Participant on the **left** side of the keyboard controls the **yellow** playing piece.
- ★ Participant on the **right** side controls the **red** playing piece.
- ★ To move your piece to the right you have to press ← and to move your piece to the left press →.
- ★ The background color of your piece indicates who's turn it is to move. When it's your turn the background of your piece will turn blue.

The goal of the game:

After some meetings you get the message "You have recieved one point", followed by the pieces being reset to the starting positions. Use both highlighted areas to optimize gains.

The more meetings, the higher is your possibility to earn points (more meetings = more points).

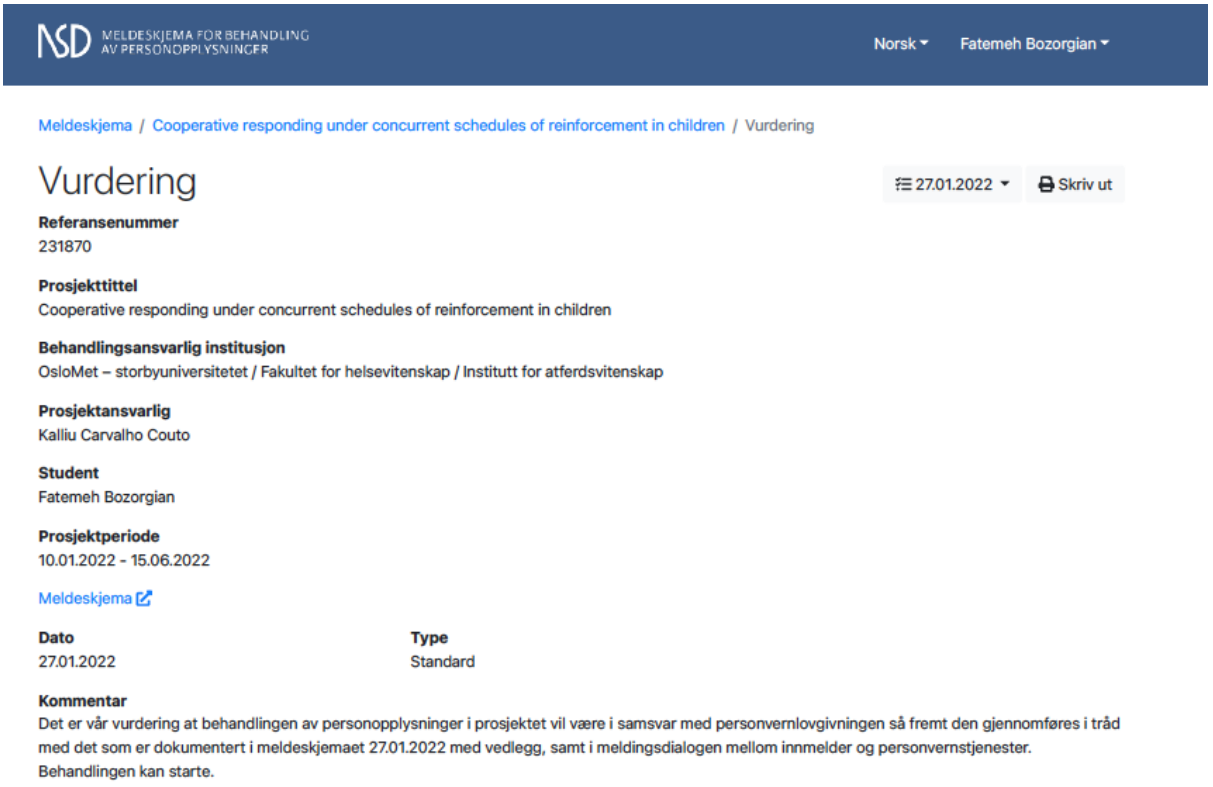
General information:

1. You will improve your performance simply by playing the game.
2. If you have any questions after reading these or the following instructions, please ask the researcher supervising the study before you begin.
3. The session is over when you see the message **"End".**
4. You are not allowed to communicate during the experimental sessions.
5. During breaks, you can talk, but you are not allowed to discuss the experiment.
6. After each session is finished, the supervising researcher will inform you about how many points you have earned.

If you have any questions about the instructions, please ask the researcher before you begin.

Appendix 4

Norsk senter for forskningsdata (NSD)



NSD MELDESKJEMA FOR BEHANDLING AV PERSONOPPLYSNINGER

Norsk ▾ Fatemeh Bozorgian ▾

Meldeskjema / Cooperative responding under concurrent schedules of reinforcement in children / Vurdering

Vurdering

27.01.2022 ▾ Skriv ut

Referansenummer
231870

Prosjekttittel
Cooperative responding under concurrent schedules of reinforcement in children

Behandlingsansvarlig institusjon
OsloMet – storbyuniversitetet / Fakultet for helsevitenskap / Institutt for atferdsvitenskap

Prosjektansvarlig
Kalliu Carvalho Couto

Student
Fatemeh Bozorgian

Prosjektperiode
10.01.2022 - 15.06.2022

Meldeskjema

Dato	Type
27.01.2022	Standard

Kommentar
Det er vår vurdering at behandlingen av personopplysninger i prosjektet vil være i samsvar med personvernlovgivningen så fremt den gjennomføres i tråd med det som er dokumentert i meldeskjemaet 27.01.2022 med vedlegg, samt i meldingsdialogen mellom innmelder og personvernstjenester.
Behandlingen kan starte.

Appendix 5

Reflection note

This project followed Norwegian Center for Research Data (NSD) and The National Research Ethics Committee for the Social Sciences and Humanities (NESH, 2016, 13) guidelines and checklist before starting the experiments.

Participants were informed and had consent from their parents to join the experiment. Children and parents were informed that they could withdraw their consent at any time and end their participation in the experiment. All the rules of privacy and confidentiality were overheld.

The experiment did not involve any collection of identifiable data and therefore there were no need to fill out a “klausuleringsskjema”, a form of confidentiality of the collected information. This type of form is used when there is personal data, research biobanks, a dispensation from secrecy, or medical and health research. This study contains none of the above and therefore it is not included as an appendix.

Institutional guidelines were also followed. Veitvet Skole approved the project as long as it was adapted to the student's timetable and in agreement with the student's teacher.

All in all the project was done successfully according to the procedural plan and ethical guidelines were overheld.