Master's Thesis

Learning in Complex Systems
November 2020

Rule-governed Behavior and Cultural Selection

A Literature Review and an Empirical Study

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Abstract

A literature review on the concept of metacontingency is presented in Article 1. Zilio (2019) provided a comprehensive review on metacontingency literature published from 1986 until April 2017. The present article continued the review of metacontingency literature, thereby, including articles published from May 2017 to September 2020. In accordance with Zilio's method, distribution of articles among domain, journals and research centers is presented in a quantitative analysis. A qualitative analysis discussed the effectiveness of the metacontingency concept and how it was employed in the different categories of articles.

An empirical study on rule-governed insensitivity in groups and microcultures is presented in Article 2. In Experiment 1, rule-governed insensitivity was tested in three groups. The groups received instructions that matched the contingency of optimal performance in Phase 1, while the contingency of optimal performance was changed in Phase 2. The results showed that one group was under instructional control, while two groups responded according to the changed contingency and maximized earnings. Experiment 2 included two microcultures, where in each, three participants completed Phase 1 and replacement of participants started in Phase 2. Instructions matched the optimal contingency of reinforcement only in Phase 1. The results showed that one microculture was sensitive to the change of contingency in Phase 2, while the other microculture responded in a pattern similar to the instructions.

Keywords: Metacontingency, cultural selection, rule-governed behavior, instructions, insensitivity, group, microculture

Sammendrag

Artikkel 1 er en litteraturgjennomgang av konseptet metakontingens. Zillio (2019) presenterte en omfattende litteraturgjennomgang over litteratur om metakontingens publisert fra 1986 til april 2017. Artikkel 1, er en fortsettelse av Zilios søk, og inkluderer derfor artikler fra mai 2017 til september 2020. I samsvar med Zilios metode er distribusjon av artikler mellom domener, tidsskrifter og forskningssentre presentert i en kvantitativ analyse, mens en konseptuell analyse tok for seg effektivitet og hvordan konseptet metakontingens ble brukt i de ulike kategoriene av artikler.

En empirisk studie av regelstyrt insensitivitet i grupper og mikrokulturer er presentert i artikkel 2. I Eksperiment 1 ble regelstyrt insensitivitet undersøkt i tre grupper. Gruppene fikk instrukser som stemte overens med kontingensen for optimal respondering i Fase 1. I Fase 2 ble kontingensen for optimal respondering forandret. Resultatene viste at den ene gruppen var under instruksjonell kontroll, mens de to andre gruppene svarte i samsvar med den endrede kontingensen og maksimerte poenginntjeningen. Eksperiment 2 inkluderte to mikrokulturer, hvor tre deltagere i hver mikrokultur fullførte Fase 1. Utskifting av deltagere begynte i Fase 2. Det var kun i Fase 1 at instruksen samsvarte med den optimale, direkte kontingensen. Resultatene viste at en mikrokultur var sensitiv ovenfor forandringen i kontingensen i Fase 2, mens den andre mikrokulturen svarte i et mønster mer likt instruksen.

Nøkkelord: Metakontingens, kulturell seleksjon, regelstyrt atferd, instruks, insensitivitet, gruppe, mikrokultur

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A Literature Review on the Effectiveness of Metacontingency as a Conceptual Tool in Cultural Selection

Artikkel I

En Litteraturgjennomgang av Effektiviteten til Metakontingens som et Konseptuelt Verktøy i Kulturell Seleksjon

Abstract

Metacontingency is used as a conceptual tool in cultural selection research. The concept has provided a variety of themes in research articles since its introduction in 1986. Recently, Zilio (2019) reviewed research on the metacontingency concept from its first publication in 1986 until April 2017. The concept's effectiveness was evaluated based on how it explained social processes and how it promoted effective action. The present literature review included articles in continuation of Zilio's search, that is, from May 2017 to September 2020. The search was conducted in three databases and eight journals, which resulted in 33 articles. The articles were classified into four thematic categories: theoretical, interpretative, experimental and applied. A quantitative analysis involved the distribution of articles among domain, journals and research centers, while a qualitative analysis involved how the metacontingency concept is employed in the different-themed articles.

Keywords: Metacontingency, Cultural selection, Cultural practices

Sammendrag

Metakontingens er brukt som et konseptuelt verktøy i studier av kulturell seleksjon. Konseptet har bidratt med et bredt spekter av temaer til forskningsartikler siden det ble introdusert i 1986. Zilio (2019) gjennomgikk nylig forskning på konseptet metakontingens, fra første publikasjon i 1986 til april 2017. Konseptets effektivitet ble evaluert på bakgrunn av hvordan det forklarte sosiale prosesser og hvordan det fremmet effektiv handling. Denne litteraturgjennomgangen inkluderte artikler i fortsettelse av Zilio sitt søk, fra mai 2017 til september 2020. Søket ble gjennomført i tre databaser og åtte tidsskrifter, hvilket resulterte i 33 artikler. Artiklene ble klassifisert i fire tematiske kategorier: teoretiske, interpretative, eksperimentelle og anvendte. En kvantitativ analyse inkluderte distribusjon av artikler blant domener, tidsskrifter og forskningssentre, mens en kvalitativ analyse tok for seg hvordan metakontingens-konseptet har blitt brukt i de ulike kategoriene av artikler.

Nøkkelord: Metakontingens, kulturell seleksjon, kulturelle praktiseringer

Glenn's article from 1986, "Metacontingencies in Walden Two" evoked a large academic debate which is still ongoing. This pioneering article impelled the development of the field of cultural selection in behavior analysis. Skinner planted the seed of the idea of a third kind of selection and his numerous works have shown that this may be a productive view. While Glenn contributed to the further development of the field of cultural selection with the concept metacontingency. Initially, metacontingency was defined as "the unit of analysis describing the functional relations between a class of operants, each operant having its own immediate, unique consequence, and a long term consequence common to all the operants in the metacontingency" (Glenn, 1986, p. 2). Two years later the definition was updated to "the metacontingency is the unit of analysis encompassing a cultural practice, in all its variations, and the aggregate outcome of all the current variations" (Glenn, 1988, p. 168). A great number of academics have been engaged and contributed to further develop the metacontingency concept. After 30 years history of the term, Glenn et al. (2016) agreed upon the following definition: "a contingent relation between 1) recurring interlocking behavioral contingencies having an aggregate product and 2) selecting environmental events or conditions" (p. 13). The development apparently was not terminated, as the constituting components of metacontingency are under ongoing discussion, as well the different functions of metacontingency in research. For instance, Baia and Sampaio (2019) distinguished the metacontingency as a unit of analysis, a process and a procedure in cultural-level research and advised upon specified usage of the term in research articles. Although metacontingency is a conceptual tool in development, it has an essential role in cultural selection, providing numerous research articles.

Zilio (2019) conducted a comprehensive review on the literature published on metacontingency, with a time frame from 1986 to April 2017. The review is titled "overview", which does not refer to the method (review of meta-analyses), rather its function

is descriptive – broad review of collected research on metacontingency from 1986 to 2017. Zilio characterized the review as an informed conceptual analysis and emphasized that it is not meant to be a systematic review or meta-analysis. The method used by Zilio (2019) included search in three databases and 16 journals that publish behavior analytic research in English, Portuguese and Spanish. The search resulted in 148 articles that employed the metacontingency concept. The papers' distribution into thematic categories (theoretical, interpretative, experimental and applied), journals and authors and their respective affiliations were represented in the quantitative analysis. Additionally, qualitative analysis evaluated the effectiveness of the metacontingency concept based on four categories (common definition, experiments, applied research and criticism on metacontingency). Zilio defined the criterion of effective action as "explaining social processes (cultural practices) and promoting effective action (i.e., solving human problems) …" (Zilio, 2019, p. 49). At the end, Zilio's argument was that the metacontingency's effectiveness as a unit of analysis in cultural selection has not been proven, and exploration of new conceptual tool was suggested.

The present literature review will examine quantitative and qualitative characteristics of metacontingency research published in the period from May 2017 to September 2020. That will say from the last date of published articles included in Zillio's review, until the date of the conducted search. In addition, the effectiveness of the metacontingency concept will be revised. The criterion of effective action suggested by Zilio (2019) appears to be too broad, as academics, scientists, even philosophers typically share the goal of promoting effective action in social and cultural domains. Thereby, theoretical and experimental research scarcely matched the set criterion of effectiveness. Despite that, theoretical and experimental research is highly appreciated within new scientific approaches, or for analyzing domains which cannot be easily manipulated, for example, cultural selection. Thus, the appropriateness of the defined effectiveness is questionable with theoretical, interpretative and experimental

research. Therefore, the present article will evaluate the metacontingency as a conceptual tool, through the cumulative impact of the reviewed articles, in means of social and cultural significance.

Method

Bibliography selection

A literature review was conducted matching Zilio's (2019) criteria. From the 16 journals and three databases which publish articles within behavior analysis, 10 journals and one database publish in English. Two of the journals have stopped publishing, thus 8 journals and one database were used for the search, shown in Table 1. The time frame selection was a continuation from Zilio's search, that is, from May 2017 to September 2020. Articles which contained the terms "metacontingency" and "metacontingencies" in titles, abstracts, keywords, main text or references were selected. Besides language and time frame, another limitation was set to only peer-reviewed articles. Thereby, book reviews and dissertations were excluded. As in Zilio (2019), articles where the terms "metacontingency" or "metacontingencies" were appearing but were not part of the main theme or part of the conceptual framework, were excluded. In particular, articles where "metacontingency" or "metacontingencies" appeared in the reference list only. An additional criterion in the present article was exclusion of commentaries and editorials. This search resulted in 33 articled that were selected for further analysis.

Categorization by Thematic Category

The selected articles were classified into four thematic categories: theoretical, applied, experimental and interpretative. Theoretical, experimental and applied research are primary research types in behavior analysis, producing knowledge which enables one or more of three

levels of understanding i.e. description, prediction and control (Cooper et al., 2013). Interpretative research type was included in accordance with the categories used by Zilio (2019).

Theoretical

This category describes the subject matter in a specific conceptual system (Hayes, 1978). Thus, articles that focused on conceptual use and issues of metacontingency were placed as theoretical. Zilio (2019) further divided this category into four subcategories, which were used in the present review. *Conceptual* included articles which focused on describing and defining metacontingency. Addition to this was changes in terminology or description of components or concepts in relation to metacontingency. A similar type of articles was categorized as *theoretical ramifications*. Articles that involve the metacontingency in explaining social and cultural processes directly, or in interdisciplinary context were placed here. The subcategory *critical* contains articles with a critical view on metacontingency and its usefulness. *Reviews* is the last subcategory which includes articles that examined research published on metacontingency.

Interpretative

Articles that focus on social and cultural processes, which included metacontingency as main part of the analytic framework, while focusing on actual problems and phenomena. Hence, interpretation conveys knowledge as if produced in experimental setting, when the phenomenon has no conditions for experimentation (Skinner, 1988, as cited in Zilio, 2019). In other words, social or cultural processes that have already happened and are not convenient for experimental setting can be interpreted through metacontingency.

Experimental

This category includes articles which account for conducted experiments within the standards of experimental research, namely "basic" research (Hayes, 1978).

Applied

Articles within applied behavior analysis were counted in this thematic type. Applied, behavioral, analytic, technological, conceptually systematic, effective and generality are the seven criteria that Baer et al. (1968) gave for judging applied research. Cooper et al. (2013) emphasized that applied behavior analysis offers society a way of solving problems that is accountable, public, doable, empowering and optimistic. Although social and cultural problem solving is a general concern for conducting research, it was especially emphasized in this category.

Organization and analysis

The present literature review is a synthesis of a narrative review and a systematic review. It is not a research synthesis (i.e. systematic review or meta-analysis) as the data extraction and analysis are not following a strict protocol as suggested by Littell et al. (2008). The purpose of accessing all the articles published in the last 3 years which include metacontingency resulted in a seemingly narrative review. However, the search method was predefined and gave a characteristic of a systematic review to the analysis (Pae, 2015). Alternatively, Zilio (2019) refers to the analysis as an "informed conceptual analysis". He denotes the conceptual analysis as mainly qualitative with additional quantitative elements. Following Zillio's (2019) method, the present review also incorporated quantitative and qualitative analysis. The quantitative part included the distribution of the articles into thematic types, journals, and dispersion of authors to affiliations. The qualitative part involves the conceptual analysis on metacontingency in the reviewed articles.

Distribution Among Thematic Categories

Table 2 presents the distribution of articles among the four categories, while Figure 1 shows the dispersion of the 33 articles by year of publication, in the search period from May 2017 to September 2020.

Most of the reviewed articles, 45.45%, were in the category of theoretical articles. Next was the category interpretative articles with 30.3%. Experimental type of articles was the third with 15.15% and the last category – applied articles included 9.09%.

Furthermore, the category of theoretical articles was divided into four subcategories, where theoretical ramification presented the majority with 60%, followed by conceptual articles with 20%, critical with 13.33% and review with 6.67%.

Conspicuous difference in the number of conceptual articles in the present paper and in Zilio's review was presumed, and probable result of the selected publication time range. Likewise, the conceptual papers from the last three years are not exclusively looking at the definition, but rather on the role of metacontingency and how it was used in a selectionist perspective (Baia and Sampaio, 2019; Couto, 2019; Sandaker, Couto and de Carvalho, 2019). Theoretical ramifications showed great diversity of themes, merging metacontingency with leadership and process safety (Alavosius et al., 2017; Gravina et al., 2017; Ludwig, 2017), corruption (da Hora & Sampaio, 2019), interprofessional care (Busch et al., 2020), marketing (Foxall, 2020), ecological and cultural system science (Mattaini, 2019), interrogation techniques (Niland & Ortu, 2020) and anthrozoology (Pfaller-Sadovsky & Hurtado-Parrado, 2020).

A prevailing characteristic was found to be common for the interpretative articles: a change in cultural practices. The majority of articles in this category interpret a necessary

change in one or more cultural practices, which resulted beneficiary for a whole society. Furthermore, some papers had a starting point in cultural practices that emerged (Malott, 2019), were arranged by officials (Baia et al., 2017) or a combination of both (Ardila Sánchez et al., 2019).

The experimental articles did not differ as much, probably an effect of the small number of articles. One paper examined cooperation in pigeons (Velasco et al., 2017), whereas the other papers examined different types of consequences on culturants (Guimarães, Leite, et al., 2019; Guimarães, Picanço, et al., 2019; Soares et al., 2019; Soares et al., 2018).

The applied research differed in the environmental setting of application, for example organization (Porto & Foxall, 2019; Robertson & Pelaez, 2018) and public facilities (Hayashi et al., 2019).

In the period from May to December 2017, there were published four theoretical articles, two interpretative and one experimental. No applied research was published, however. The result from 2018 is surprisingly low, with only one experimental and one applied article in the whole year. Contrary, 2019 was a rather fruitful year with 22 published papers. Nine of these were theoretical, eight were interpretative, three were experimental and two were applied articles. A similar discrepancy, as in 2018, was visible in the period from January to September 2020. There were only two theoretical articles published on metacontingency in this period.

Distribution among journals

Figure 2 depicts the quantity of articles in the reviewed journals and databases, by thematic category. From the seven reviewed journals, five provided results, while two journals, *Journal of Applied Behavior Analysis* (JABA) *and Journal of Experimental Analysis*

of Behavior (JEAB), did not provide any papers on metacontingency. Intriguingly, the two central journals for publishing applied and experimental research, respectively, had not published any on metacontingency. On the other hand, *The Psychological Record* (TPR) had published one experimental paper in the period from May 2017 to September 2020. Similarly, the search in *European Journal of Behavior Analysis* (EJOBA) resulted in one article as well, which was theoretical. One applied article was published in *Journal of Organizational Behavior Management* (JOBM) along with three theoretical articles. The acknowledged journal, *The Behavior Analyst* (TBA) publishes as *Perspectives on Behavior Science* (PoBS) from 2018. The search in this journal resulted in five articles, all under PoBS. One of these articles was experimental, one interpretative and three were theoretical papers. The journal with significantly higher number of articles on metacontingency was *Behavior and Social Issues* (BSI). The search in the journal in the period of May 2017 to September 2020 resulted in 22 articles in total. Nine of the papers were interpretative, six were theoretical, three were experimental and one was applied. The great number of interpretative articles lends support to the utility of metacontingency in social issues. Additionally, the search in three databases, *PubMed Central* (PMC), *PsycINFO* (PSYC) and *Scopus* resulted in great number of articles, yet only three articles complied with the search criteria and were not duplicates of the search in the journals. The search in PMC resulted in articles that were already included. The search in PsycINFO resulted in one applied article from the journal *Behavioral Development*. The search in Scopus provided two theoretical articles. One from the journal *Managerial and Decision Economics*, and the other from *Journal of Interprofessional Care*. Thereupon, the total number of different journals is ten, although only seven were directly reviewed.

Institutions Studying the Metacontingency

Zilio (2019) analyzed principal researchers and respective affiliations which study the metacontingency, based on number of published articles. Only those related to at least five published works were part of the analysis. On account of the lower number of articles, only centers that study the metacontingency were analyzed in this paper, while authors were not included. Additional adjustment was in the criterion, which was lowered to at least three published articles. A total of six affiliations qualified with the present precedent. With five articles, Universidade Federal do Pará had the highest number of publications on metacontingency in the last three years. Next, with four publications was another Brazilian institution - Imagine Tecnologia Comportamental, which is closely associated with Universidade Federal do Pará. In other words, the four publications of Imagine Tecnologia Comportamental were in collaboration with Universidade Federal do Pará. A third Brazilian affiliation with three publications was Universidade de Rio Verde. Likewise, the other three institutions have published three papers on metacontingency in the period from May 2017 to September 2020. Two of them were from the US – University of North Texas and University of Reno, and one was from Norway - Oslo Metropolitan University. To summarize, half of the affiliations that publish research on metacontingency were from Brazil, with total of 12 articles. The other half was represented with two affiliations from the US and one from Norway. These results are in accordance with Zilio's analysis, even though the number of articles was lower in the present review.

Theoretical research on metacontingency

One of the conceptual articles discussed metacontingency terminology. After the first article introduced the term (Glenn, 1986), there have been long development of the term metacontingency, for instance in the definition and its components. Baia and Sampaio (2019)

pointed to the inconsistency in the use and meaning of metacontingency in the literature. They refered to the cumulative work of Glenn et al. (2016) in the field of cultural analysis and their contribution with an updated definition of the term. However, Baia and Sampaio further argued the meaning of the term and its application in research. Even though metacontingency was commonly used as a unit of analysis, sometimes it was used as a process or a procedure. Nonetheless, Baia and Sampaio argued for the incompatibility of metacontingency as a unit of analysis, as the dependent variable would then be an entire set of interlocking behavioral contingencies, an aggregate product and a cultural consequence. They suggested that the term *culturant* is more appropriate unit of analysis, hence it should be the main unit in cultural selection. The metacontingency as a procedure, on the other side, was acknowledged as correctly used and Baia and Sampaio agree with the application of metacontingency as a procedure by Glenn et al. (2016). Furthermore, they advised against the use of metacontingency as a process of cultural selection, on account of interference with the description of the effects of the cultural consequence. A suggested solution for describing cultural selection as a process was the adoption of the terms *culturant increase* and *culturant decrease* (Baia & Sampaio, 2019). The proposed changes in terminology use would ease the understanding of cultural selection experiments and, apparently. the comprehension of cultural selection.

Couto (2019) discussed one of the constituents of metacontingency – interlocking behavioral contingencies (IBCs) and their role in selection of cultures. This brought the terminology in behavioral cultural science a step further, because selection of cultures occurs only at the cultural level (Couto & Sandaker, 2016) and is distinguished from cultural selection, which may occur at the behavioral level as well. Coordinated social behavior and cooperation were suggested as basic units of selection for groups, which led again to the IBCs. As a result of their adaptive function, “specific patterns of IBCs will become recurrent

among populations, and they may have at least two functions: They may be directly involved in the production of aggregate products (APs) and the selection and maintenance of new and current members' behavior" (Couto, 2019, p.41). IBCs that participate in improvement of APs were named *execution IBCs* (eIBCs), whereas those involved in within-group stimulus control were called *controlling IBCs* (cIBCs). These two types are possible recurrent sets of IBCs, which help in the distinguishing between cultural selection and selection of cultures (Couto, 2019).

Sandaker et al. (2019) brought a new dimension to behavior analysis in understanding behavior and cultural practices, namely structure. They argued that selection exclusively cannot completely describe the evolution of cultures, thus structure is suggested as something that must be selected, before selection has occurred. Moreover, patterns of interactions among two or more individuals might become recurrent and persistent over generations. Therefore, mapping a net of relations within IBCs is likely to provide data on the structural aspect of cultural practice. Sandaker et al. defined structure as "the nesting of interlocking behavior contingencies (n-IBCs), which became recurrent and is transmitted over time" (p.225). Recognizing structures as coordinated networks of contingencies offered predictive significance and helped in understanding behavior and cultural practices (Sandaker et al., 2019).

Two articles had a critical view on metacontingency as a unit of analysis in cultural selection. Krispin (2017) extended the discussion on cultural selection versus selection of cultures and agreed that selecting processes in a metacontingency involve selection within-groups and not between groups. With a standpoint from systems theory, Krispin introduced positive feedback loops as an important component for understanding the selection of cultures. Positive feedback loops have amplifying effect and might result in selection of

specific positive-feedback loop and its constituents, which is the foundation of a selection process that possibly operates between groups. Moreover, positive feedback loops were characterized as self-organizing systems which threaten the metacontingency. However, Krispin (2017) concluded that the possibility of third type of selection still exists, where metacontingency might be an elementary unit of selection, although the involved processes are fully unlike than the previously suggested ones.

Krispin (2019) developed the discussion and introduced a novel concept - *culturo-behavioral hypercycles*. Krispin stressed again the incorporation of self-organized systems theory as a threat to the metacontingency, which was a proposed process of cultural-level selection. The previously mentioned positive feedback loops were then called *culturant hypercycles*. Krispin (2019) further explained:

> In a culturant hypercycle, a set of culturants forms such that, for each culturant included in the system, the culturant both selects an aggregate product produced by another culturant in the system as an input into its process and itself produces an aggregate product that is selected by another culturant in the set. (p.874)

That presented how closed feedback loop of metacontingencies are formed. Characteristics of self-organizing systems like homeostatic response, own defining of boundaries and centripetality were attributed to culturant hypercycles. Krispin concluded that a comprehensive model of cultural selection will likely involve additional processes, thereby encouraged further discussion and interdisciplinary knowledge in the field of cultural change.

Theoretical ramifications

Several articles in this subcategory involved the metacontingency in explaining social and cultural processes directly, whereas some articles applied it in interdisciplinary context.

Corruption is one social issue that had been operationalized with direct use of metacontingency terminology. Da Hora and Sampaio (2019) proposed different units of analysis for studying behavioral and cultural dimensions of corruption. On the individual level, *corrupt operant* was used as a unit, whereas on cultural level the suggested unit was *corrupt culturobehavioral lineage*. Interestingly, *corrupt culturant* ws a unit suggested for corrupt transactions, considering the interactions needed the term as an analogy to metacontingency (da Hora & Sampaio, 2019).

Another article that focused on an important social issue, analysed false confessions and interrogation techniques. Niland and Ortu (2020) described how behavior analysts are contributing as expert-witnesses in uncovering false confessions. Furthermore, a systemic analysis was proposed for understanding larger units that involve behavior of more than one person. The broad interrogation process that involves the interrogator, the suspect or more agents were described to be maintained by metacontingencies (Niland & Ortu, 2020).

The interaction between humans and dogs has changed over time, thereby Pfaller-Sadovsky and Hurtado-Parrado (2020) analyzed the matter through the three levels of selection. The start of cooperation between dogs and humans has probably resulted from artificial selection of pro-social dogs, also called *proto-dogs* (Pfaller-Sadovsky & Hurtado-Parrado, 2020). Coordination and cooperative hunting with proto-dogs was described as a metacontingency, as the interlocking behavior of the two resulted in food (AP), which further stimulated this cooperation.

Mattaini (2019) considered the challenges of modern society, which involved inequality and marginalization, violence, conflicts and wars, climate change, depletion of common resources etc. All these issues emerge and the root in behavior, therefore Mattaini called scientists to act out of the lab and create solutions that would be directly applied in the

society. The limitations of cultural systems science to be confined by theory and methodology were acknowledged by Mattaini, thereby a suggested resolution was to expand on ecological science and theories of complex systems. Metacontingency was discussed under complexity within behavioral systems, where examples explained the use in everyday life (Mattaini, 2019).

An article published in Journal of Interprofessional Care commended behavior analysis and the concept metacontingency, despite that it was a non-behavior analytical journal. Busch et al. (2020) introduced interprofessional collaboration as an important asset in mental health care. Several medical and social professions are required to cooperate for achieving cumulative result for a patient. Metacontingency was used for describing the interlocking behaviors among the different professional profiles. In addition, metacontingency was involved in keeping the value of every particular contribution of the members in the team (Busch et al., 2020).

Organizations have utilized the behavior analytic framework and continuously have used the metacontingency in applied and theoretical research, as well. For example, Alavosius et al. (2017) developed and analyzed *Crew Resource Management* (CMR) based on crew behavior. Teamwork was operationalized as a metacontingency and the role of verbal behavior was emphasized as a source for coordinating individual and group behaviors. The possibility of measuring communication networks, instructions, rules, verbal cooperation and interlocked behaviors in teamwork leadership, resulted in measuring skills of CRM (Alavosius et al., 2017).

Another organizational aspect where metacontingency took place as a conceptual tool was process safety and leadership’s role in it. Behavior-based safety had shown successful downgrading of injuries at work, therefore Gravina et al. (2017) concentrated process safety

at the behavior of leaders. Leaders have complex tasks in deciding about budget, strategy, priorities and this was presented as a metacontingency. In addition, knowledge about antecedents and consequences was necessary for leaders, on account of the decisions they make for workers and implementation (Gravina et al., 2017). In other words, the theoretical advancement would result in applied models that give better results.

Ludwig (2017) likewise discussed behavioral components in process safety. Organizational Behavior Management is the branch of behavior analysis that developed practical tools for minimizing injuries at work. Ludwig explained that behaviors of individual agents in the system of chains or structure, impacted the behavior and outcome of behavior of other agents. Within such metacontingencies, behaviors of one agent in the organization acted as antecedents and consequences for others' behavior. Therefore, the importance of creating tools which help leaders to sustain metacontingencies is emphasized (Ludwig, 2017).

A novel application of the metacontingency was provided by Foxall (2020), who proposed a theory of the marketing firm as a metacontingency. Foxall discussed that behavior analysis is known for single-subject studies and employment of the three-term contingency for measuring individual behavior. Contrary, he argued that organization's behavior cannot be measured with the same approach. Foxall further argued that organization's behavior indicates its structure as a system of IBCs. Furthermore, the interaction of individuals with the firms, and between firms is characterized as a metacontingency, as the final product is a result of interwoven contingencies (Foxall, 2020).

Experimental research on metacontingency

Soares et al. (2018) conducted a study where the effect of verbal and non-verbal consequences on a culturant was measured. Additionally, the competition between operant contingencies and metacontingencies was examined. Total number of participants was 123

students, who formed four microcultures with three culturo-behavioral lineages in each. Three participants forming a microculture worked together on a task which included a matrix with ten rows (1-10) and ten columns (A-J). Different combinations of chosen rows and columns resulted in tokens that were later exchanged for money. In two of the microcultures the experimental design imposed competition between choosing a combination that would result in more money for the individual or choosing a combination that would result in a stamp for donation items. The results showed that the target culturant had more stable rate in the microcultures with no competition (Soares et al., 2018).

Soares et al. (2019) further examined concurrency of operant contingencies and metacontingencies and their effect on a targeted culturant. In addition, the cultural consequences were varied as continuous or intermittent. The experimental design resembled to the previous experiment, namely four microcultures where only two had concurrency between the metacontingency and the operant contingencies. The results showed that microcultures exposed to concurrency did not choose combinations to produce the target culturants, whereas microcultures without concurrency presented selective effects of the cultural consequence on target culturants (Soares et al., 2019).

Another study examined the effect of punishment on laboratory microcultures. Guimarães, Leite, et al. (2019) tested individual punishment and punishment dependent on group performance. The participants chose rows in a colored matrix and consequences were delivered contingent upon individual choices in Experiment 1, while in Experiment 2 consequence were contingent upon the aggregated choice of the three participants in the microculture. The results showed notable effect of individual punishment on the individual target in Experiment 1. Likewise, in Experiment 2 the results showed effects of the group-level punishment on the target culturant (Guimarães, Leite, et al., 2019).

Guimarães, Picanço, et al. (2019) expanded the research and measured negative punishment on culturants in a setting with concurrent operant contingencies and metacontingencies. Three different conditions were tested on three microcultures of three participants each. The choice of even-rows resulted in one red token that was needed for the cultural consequence, while a chosen odd-row resulted in three blue tokens – an individual consequence. Guimarães, Picanço, et al. (2019) called even-row responses ethical self-control, while odd-row responses were named impulsive responses. The results showed that negative punishment reduced impulsive culturants and increased the self-controlled culturant.

Intriguingly, one experiment examined metacontingency in pigeons. Velasco et al. (2017) set conditions for individual behaviors and interlocked behaviors of a pair of pigeons. The consequence for individual behavior was 3-s access to food, while the coordinated behavior resulted in mutual consequence of additional 4 s access. The results are described as

> the mutual contingency of reinforcement led to (a) a slight reduction of the production of individual and mutual consequences without any coordinated response pattern; (b) the maintenance of high percentages of individual consequences with a concomitant increase in mutual consequences; and (c) for only one subject, an increase in the production of mutual consequences that were accompanied by a decrease in the rate of individual consequences. (Velasco et al., 2017, p.537)

Metacontingency research in applied setting

Porto and Foxall (2019) presented the marketing firm as a metacontingency and their empirical study on the mutual relationship between the firm's behavior and produced financial consequences. Collected data over 17 years was analyzed in the means on marketing expenses and financial outcomes. The investment in marketing activities was presented as the AP of the IBCs of the firm, while the financial reinforcements as consequences of AP. The

results implied mutual effects between marketing investments and some on the indicators of the consequence of the AP, namely financial performance (Porto & Foxall, 2019).

Organizational change through rule-governed behavior was applied in a large metropolitan university, in order to induce graduation on time. Robertson and Pelaez (2018) used metacontingency terminology for description of the interlocks between university's administration advisors and the behavior patterns that promoted delayed graduation. The metropolitan university had introduced several rules and practices which promoted graduation on time, thereby, the metacontingency of rules analysis and provided institutional help resulted in bigger percent on-time graduated students (Robertson & Pelaez, 2018).

Hayashi et al. (2019) planned and applied a cultural design in order to change a cultural practice of littering. The intervention was called *Solid Waste Management* and was carried out in suburban neighborhood in Paraná State, Brazil. Children participating in a local NGO were thought to select waste in the different recycling bins. Hayashi et al. (2019) conclude that the behavior of the children who participated in the intervention affected the general practice of littering. This change in the cultural practice is recognized as a metacontingency.

Interpretative research on metacontingency

Fava and Vasconcelos (2017) interpreted a beneficiary legislation through behavior analytic lens. Metacontingencies were described in *Programa Bolsa Familia*, legislation with target to improve the life standard of poor families in Brazil. The government payed conditioned cash to families if they fulfiled the requirements of education and health. The cultural practice that had kept these families in poverty is explained as metacontingency: interlocking contingencies which impede the schooling and nutrition of poor children, who become adults without qualifications for the labour market, therefore get low-paid job and

maintain the cycle of poverty across generations (Fava & Vasconcelos, 2017). The second described metacontingency in the program was management and control of the behavior of beneficiaries by government officials. IBCs of local and federal advisors in management of the conditionalities resulted in products like compliance to the conditionalities and growth in the access to education and health services. The cultural consequence was sustained beneficiary program and ground for creating similar programs to solve social issues.

Baia et al. (2017) interpreted ethnogenesis of a Brazilian indigenous community through metacontingencies. The analysis included "relationship between the Xavante and Kayapó configures interlocking metacontingencies" (Baia et al., 2017, p. 56). Behavior of Xavante is emphasized as IBCs, allowing the indigenous people to stay in the village (AP), where the consequence was no war between the groups.

Tagliabue and Sandaker (2019) interpreted a previous experiment that used nudges for the purpose of minimizing food waste in restaurants. With behavior analytic approach and metacontingency analysis, Tagliabue and Sandaker illustrated that lowering food waste in restaurants can be simple through a behavioral intervention with planned cooperative contingencies.

An extensive employment of the metacontingency had been used by Malott (2019) for analyzing a cultural cusp in Mexico, where artists created a movement by painting murals. Malott analysed the interaction of art and politics, cooperation of muralist to create a mural and the contingencies created in the environment. Lineages of mural-making metacontingencies sustained the movement and interest for mural programs in other countries, too. (Malott, 2019).

Freitas Lemos et al. (2019) combined Ostrom's management of common pool resources and behavioral analytic approach with a purpose of improved interventions and

prevented depletion of common resources. Freitas Lemos et al. (2019) illustrated an example of Brazilian local community that successfully managed a common sustenance – fiddler crab. Two metacontingencies were presented, one describing permission and the other one prohibition. Those two metacontingencies clearly stated characteristics of the crab, thereby, when it was allowed for fishing or not, which followed by the behavior of the appropriators would result in income or fine.

Similarly, Malott and Glenn (2019) integrated institutional and culturo-behavioral analyses in the management of common pool resources. The combined framework was applied to the appropriators' management of an inland lake in Michigan. The metacontingency helped the analysis of institutional IBCs, which together with appropriators' macrobehavior directed to revised rules for management.

Borba (2019) also integrated IBCs and maintenance of common pool resources, with a practical example of the açaí berries in the Brazilian Amazon. Borba described the importance of this resource for the local people and how the market profit selected new IBCs, which were not necessarily beneficial in long-term. On the contrary, without regulation the common cultural practice would lead to depletion.

Ardila Sánchez et al. (2019) examined the effect of weather disasters on community resilience. The descriptive analysis included the reactions of the citizens of Puerto Rico to Hurricane Maria's landfall, as well as the emerging metacontingencies in the recovery operation. One metacontingency delivered information on how governmental and official institutions acted in relieving the damage from the hurricane, whereas the other metacontingency informed about officials cooperating with profit and non-profit companies. The conclusion of Ardila Sánchez et al. (2019) suggested that resilient actions have greater

effect when macro- and metacontingencies were concentrated in a cultural milieu connected to the ecological boundaries, than the present state of affairs of federal organizations.

Another important issue – the Syrian refugee crises was interpreted through behavior-analytic lens. Levy et al. (2019) illustrated interlocked behaviors of lobbyists, policy makers, business leaders and politicians could result in changed policies for refugees. Furthermore, complementary analyses were suggested, as the purpose of the article was to illustrate the variety of behavior-analytic principles, which should be used for solving social issues.

Al-Nasser et al. (2019) analyzed the metacontingencies that sustained honor crimes as a cultural practice against women in the Hashemite Kingdom of Jordan. Two-leveled analyzes identified the socio-IBCs transferred through generations and the legal practices (AP) that preserved the abominable cultural practice.

Conclusion

The review of metacontingency literature published in the period from May 2017 to September 2020 provided fruitful results. The 33 articles were subjected to quantitative and qualitative analysis. The quantitative analysis included distribution into thematic categories, journals and institutions. The qualitative component involved conceptual information about how the metacontingency was utilized in the reviewed articles. Zilio (2019) reported 70 articles on metacontingency in the period from 2010 to 2017. Adding the 33 articles from the last three years illustrates linear growth on published metacontingency research in the last decade. The main journal that publishes metacontingency research is BSI, consistent with Zilio's findings. The quantitative results on distribution by thematic category also resemble the results presented by Zilio. Moreover, the present review indicates Brazil, the US and Norway as principal centers studying the metacontingency, which is consistent with the finding of Zilio (2019). These results indicate that metacontingency is recognized as an

effective conceptual tool by researchers in the field of behavior and cultural analysis. Indirect measurement of the metacontingency efficacy is found in its cumulative impact in the field of cultural selection, which implies effective action in social and cultural domains.

The increasing number of published metacontingency articles in the recent years and the extended interest in research outside behavior analysis also demonstrates its efficacy. Nevertheless, Zilio (2019) argued for the contrary. The selected themes for qualitative analysis in Zilio's review looked at common definition of metacontingency, experimental and applied research, and criticisms on metacontingency. In other words, the development of metacontingency definition judged the concept as a promotor of action in cultural practices, as well. In contrast, inclusion of criticism identifies inconsistencies and discrepancies which can be indirect measure of its efficacy. To avoid bias and methodological issues, the qualitative analysis in the present review included all articles. Presented by thematic category, a brief explanation of the articles included how metacontingency was utilized in each. There were only two articles that are critical towards the metacontingency as a unit of analysis, or as a process of cultural selection. One article discusses exactly the inconsistency of the function of metacontingency, thus Baia and Sampaio (2019) conclude that metacontingency should be used as a procedure, while culturant as a unit of analysis. The great number of theoretical ramifications indicates broad use of the metacontingency, as well. One of the papers in this subcategory, Busch et al. (2020), utilizes metacontingency to describe the contingent work of different medical and social professions, in assisting patients in mental health care. Whereas, Mattaini (2019) encourages academics to move the focus from the lab and to work towards solutions for the contemporary societal problems. This acknowledges the need for expansion in the applied research. Zilio (2019) also noted this, and additionally argued that the metacontingency has found its place in applied research as an organizational tool, instead of a cultural planning tool. Organizational research often

incorporates the metacontingency in describing the interwoven roles of different job positions for instance. That is not cultural planning per se, although one can make an analogy of an organization or a firm to a smaller society.

The deficiency of applied and experimental research can be an implication of the unfeasibility to create a society for testing or changing cultural practices. One would assume the same reason for Skinner (1948) writing about "Walden Two" instead of creating it. Zilio (2019) criticizes the purely theoretical origin of metacontingency and the interpretations that are not based on experiments. One can argue the possibility and ethical implications of creating experimental and applied research that would resemble a culture and real society, instead of microcultures. Therefore, increasing amounts of interpretative research identifies the demand of cultural change and the complexity of that implementation. Interpretative research on metacontingency is valuable because it offers descriptive analysis on social and cultural issues, changed cultural practices, advanced societies. Those often provide theoretical and applied implications for solving the same or similar issues (Ardila Sánchez et al., 2019; Borba, 2019; Fava & Vasconcelos, 2017; Freitas Lemos et al., 2019; Levy et al., 2019). The majority of the reviewed articles focused on solving human problems, whether in explanatory or in applied setting, where metacontingency is often used for pinpointing the necessary interlocks of behavior that result in change of social and cultural practices. Once the interwoven behaviors for producing the desired product are pinpointed, one can easily change parts of their structure, without impacting the product demanded by the selecting environment. This is an analogy to culture, defined as a complex system with evident properties that evolve over time, even when the members of that culture are substituted (Sandaker et al., 2019). A conceptual tool that analyze the separate interlocks of behavior which allow change of cultural practices without changing the whole culture, is therefore an effective tool for conducting research within cultural selection.

References

Al-Nasser, T., Burleigh, K. J., Ardila Sánchez, J. G., & Houmanfar, R. A. (2019, 2019/11/01). Metacontingency and Macrocontingency Analysis Related to Honor Crimes in the Hashemite Kingdom of Jordan. *Behavior and Social Issues, 28*(1), 140-159. https://doi.org/10.1007/s42822-019-00021-y

Alavosius, M. P., Houmanfar, R. A., Anbro, S. J., Burleigh, K., & Hebein, C. (2017, 2017/04/03). Leadership and Crew Resource Management in High-Reliability Organizations: A Competency Framework for Measuring Behaviors. *Journal of Organizational Behavior Management, 37*(2), 142-170. https://doi.org/10.1080/01608061.2017.1325825

Ardila Sánchez, J. G., Houmanfar, R. A., & Alavosius, M. P. (2019, 2019/11/01). A Descriptive Analysis of the Effects of Weather Disasters on Community Resilience. *Behavior and Social Issues, 28*(1), 298-315. https://doi.org/10.1007/s42822-019-00015-w

Baer, D. M., Wolf, M. M., & Risley, T. R. (1968). Some current dimensions of applied behavior analysis. *J Appl Behav Anal, 1*(1), 91.

Baia, F. H., Neves, S. M. M., Filho, J. C. d. R. A., de Melo Junior, I. F., Souza, A. C. G., & Lemes, I. G. (2017, 2017/05/01). Ethnogenesis of a Brazilian Indigenous Community, A Behavior Analytic Interpretation: Ethnogenesis of the Tapuios do Carretão. *Behavior and Social Issues, 26*(1), 51-66. https://doi.org/10.5210/bsi.v26i0.6856

Baia, F. H., & Sampaio, A. A. S. (2019, 2019/11/01). Distinguishing Units of Analysis, Procedures, and Processes in Cultural Selection: Notes on Metacontingency

Terminology. *Behavior and Social Issues, 28*(1), 204-220. https://doi.org/10.1007/s42822-019-00017-8

Borba, A. (2019, 2019/11/01). The Selection of Different Interlocked Behavioral Contingencies and Maintenance of Common Pool Resources: The Case of the Production of Açaí Berries in the Brazilian Amazon. *Behavior and Social Issues, 28*(1), 229-247. https://doi.org/10.1007/s42822-019-00016-9

Busch, L. P. A., Porter, J., & Barreira, L. (2020, 2020/03/03). The untapped potential of behaviour analysis and interprofessional care. *Journal of Interprofessional Care, 34*(2), 233-240. https://doi.org/10.1080/13561820.2019.1633292

Cooper, J. O., Heron, T. E., & Heward, W. L. (2013). *Applied Behavior Analysis*. Harlow: Pearson Education UK.

Couto, K. C. (2019, 2019/11/01). Tutorial: Selection of Cultures and the Role of Recurrent Contingencies and Interlocking Behavioral Contingencies. *Behavior and Social Issues, 28*(1), 37-45. https://doi.org/10.1007/s42822-019-0001-y

Couto, K. C., & Sandaker, I. (2016, 2016/05/01). Natural, Behavioral and Cultural Selection-Analysis: an Integrative Approach. *Behavior and Social Issues, 25*(1), 54-60. https://doi.org/10.5210/bsi.v25i0.6891

da Hora, K. L., & Sampaio, A. A. S. (2019, 2019/12/01). Units of Analysis for Corruption Experiments: Operant, Culturobehavioral Lineage, Culturant, and Macrobehavior. *Perspectives on Behavior Science, 42*(4), 751-771. https://doi.org/10.1007/s40614-019-00225-y

Fava, V. M. D., & Vasconcelos, L. A. (2017). Behavior of Programa Bolsa Família beneficiaries: A behavior analytic perspective on fulfillment of education and health conditionalities. *Behavior and Social Issues, 26*. https://doi.org/10.5210/bsi.v26i0.7825

Foxall, G. R. (2020). The theory of the marketing firm. *Managerial and Decision Economics, 41*(2), 164-184. https://doi.org/10.1002/mde.3047

Freitas Lemos, R., Favacho, C. R. N., Favilla, K. C., & Baia, F. H. (2019, 2019/11/01). Managing Environmental Policies: Lessons From Traditional Communities. *Behavior and Social Issues, 28*(1), 269-297. https://doi.org/10.1007/s42822-019-00022-x

Glenn, S. S. (1986, 1986/05/01). Metacontingencies in Walden Two. *Behavior Analysis and Social Action, 5*(1), 2-8. https://doi.org/10.1007/BF03406059

Glenn, S. S., Malott, M. E., Andery, M. A. P. A., Benvenuti, M., Houmanfar, R. A., Sandaker, I., Todorov, J. C., Tourinho, E. Z., & Vasconcelos, L. A. (2016, 2016/05/01). Toward Consistent Terminology in a Behaviorist Approach to Cultural Analysis. *Behavior and Social Issues, 25*(1), 11-27. https://doi.org/10.5210/bsi.v25i0.6634

Gravina, N., Cummins, B., & Austin, J. (2017, 2017/07/03). Leadership's Role in Process Safety: An Understanding of Behavioral Science Among Managers and Executives Is Needed. *Journal of Organizational Behavior Management, 37*(3-4), 316-331. https://doi.org/10.1080/01608061.2017.1340925

Guimarães, T. M. M., Leite, F. L., de Carvalho Neto, M. B., Tourinho, E. Z., & Tonneau, F. (2019, 2019/11/01). The Effects of Punishment in Laboratory Microcultures.

Behavior and Social Issues, 28(1), 160-173. https://doi.org/10.1007/s42822-019-00004-z

Guimarães, T. M. M., Picanço, C. R. F., & Tourinho, E. Z. (2019, 2019/12/01). Effects of Negative Punishment on Culturants in a Situation of Concurrence between Operant Contingencies and Metacontingencies. *Perspectives on Behavior Science, 42*(4), 733-750. https://doi.org/10.1007/s40614-019-00224-z

Hayashi, C. M., Woelz, T. A. d. R., & de Melo, C. M. (2019, 2019/11/01). Solid Waste Management: Planning and Implementation of a Cultural Design. *Behavior and Social Issues, 28*(1), 316-337. https://doi.org/10.1007/s42822-019-00019-6

Hayes, S. C. (1978). Theory and technology in behavior analysis. *Behav Anal, 1*(1), 25-33. https://doi.org/10.1007/BF03392370

Krispin, J. (2017, 2017/05/01). Positive Feedback Loops of Metacontingencies: A New Conceptualization of Cultural-Level Selection. *Behavior and Social Issues, 26*(1), 95-110. https://doi.org/10.5210/bsi.v26i0.7397

Krispin, J. (2019, 2019/12/01). Culturo-behavioral Hypercycles and the Metacontingency: Incorporating Self-Organizing Dynamics into an Expanded Model of Cultural Change. *Perspectives on Behavior Science, 42*(4), 869-887. https://doi.org/10.1007/s40614-019-00212-3

Levy, S., Vaidya, J., Dettmering, J., Siebold, A. N., Mittelman, C., & Garner, J. (2019, 2019/11/01). Addressing Social and Global Issues: Viewing the Syrian Refugee Crisis Through a Behavior-Analytic Lens. *Behavior and Social Issues, 28*(1), 77-98. https://doi.org/10.1007/s42822-019-00018-7

Littell, J. H., Corcoran, J., & Pillai, V. (2008). *Systematic Reviews and Meta-Analysis*. Oxford University Press, USA. https://books.google.no/books?id=UpsRDAAAQBAJ

Ludwig, T. D. (2017, 2017/07/03). Process Safety Behavioral Systems: Behaviors Interlock in Complex Metacontingencies. *Journal of Organizational Behavior Management, 37*(3-4), 224-239. https://doi.org/10.1080/01608061.2017.1340921

Malott, M. E. (2019, 2019/12/01). How a Few Individuals Brought about a Cultural Cusp: From a Mexican Mural Program to a Movement. *Perspectives on Behavior Science, 42*(4), 773-814. https://doi.org/10.1007/s40614-019-00211-4

Malott, M. E., & Glenn, S. S. (2019, 2019/11/01). Integrating Institutional and Culturo-Behavioral Analyses in the Management of Common Pool Resources: Application to an Inland Lake in Michigan. *Behavior and Social Issues, 28*(1), 248-268. https://doi.org/10.1007/s42822-019-00014-x

Mattaini, M. A. (2019, 2019/12/01). Out of the Lab: Shaping an Ecological and Constructional Cultural Systems Science. *Perspectives on Behavior Science, 42*(4), 713-731. https://doi.org/10.1007/s40614-019-00208-z

Niland, H., & Ortu, D. (2020, 2020/01/09). Confessions Selected by Consequences: An Operant Analysis of False Confessions and Interrogation Techniques. *Behavior and Social Issues*. https://doi.org/10.1007/s42822-019-00025-8

Pae, C.-U. (2015). Why Systematic Review rather than Narrative Review? *Psychiatry investigation, 12*(3), 417-419. https://doi.org/10.4306/pi.2015.12.3.417

Pfaller-Sadovsky, N., & Hurtado-Parrado, C. (2020). A cultural selection analysis of human-dog interactions – A primer. *European Journal of Behavior Analysis*, 1-27. https://doi.org/10.1080/15021149.2020.1791682

Porto, R. B., & Foxall, G. R. (2019, 2019/10/02). The Marketing Firm as a Metacontingency:Revealing the Mutual Relationships between Marketing and Finance. *Journal of Organizational Behavior Management, 39*(3-4), 115-144. https://doi.org/10.1080/01608061.2019.1666774

Robertson, D. L., & Pelaez, M. (2018). Rules, rule-governed behavior, and organizational change in a large metropolitan research university. *Behavioral Development, 23*(1), 1-13. https://doi.org/10.1037/bdb0000066

Sandaker, I., Couto, K. C., & de Carvalho, L. C. (2019, 2019/11/01). Selection at Three Levels of Organization: Does Structure Matter? *Behavior and Social Issues, 28*(1), 221-228. https://doi.org/10.1007/s42822-019-00020-z

Skinner, B. F. (1948). *Walden Two*. Macmillan.

Soares, P. F. d. R., Martins, J. C. T., Guimarães, T. M. M., Leite, F. L., & Tourinho, E. Z. (2019, 2019/11/01). Effects of Continuous and Intermittent Cultural Consequences on Culturants in Metacontingency Concurrent With Operant Contingency. *Behavior and Social Issues, 28*(1), 189-202. https://doi.org/10.1007/s42822-019-00009-8

Soares, P. F. d. R., Rocha, A. P. M. C., Guimarães, T. M. M., Leite, F. L., Andery, M. A. P. A., & Tourinho, E. Z. (2018, 2018/05/01). Effects of Verbal and Non-Verbal Cultural Consequences on Culturants. *Behavior and Social Issues, 27*(1), 31-46. https://doi.org/10.5210/bsi.v27i0.8252

Tagliabue, M., & Sandaker, I. (2019, 2019/11/01). Societal Well-Being: Embedding Nudges in Sustainable Cultural Practices. *Behavior and Social Issues, 28*(1), 99-113. https://doi.org/10.1007/s42822-019-0002-x

Velasco, S. M., Benvenuti, M. F. L., Sampaio, A. A. S., & Tomanari, G. Y. (2017, 2017/12/01). Cooperation and Metacontingency in Pigeons. *The Psychological Record, 67*(4), 537-545. https://doi.org/10.1007/s40732-017-0256-x

Zilio, D. (2019, 2019/11/01). On the Function of Science: an Overview of 30 Years of Publications on Metacontingency. *Behavior and Social Issues, 28*(1), 46-76. https://doi.org/10.1007/s42822-019-00006-x

Table 1

Overview of journals and databases reviewed

	Journal	**Abbreviation**	**Nr. Art.**
1	Behavior and Social Issues	BSI	19
2	European Journal of Behavior Analysis	EJOBA	1
3	Journal of Applied Behavior Analysis	JABA	0
4	Journal of Experimental Analysis of Behavior	JEAB	0
5	Journal of Organizational Behavior Management	JOBM	4
6	The Behavior Analyst / Perspectives on Behavior Science	TBA/PoBS	5
7	The Behavior Analyst Today	TBAT	0
8	The Psychological Record	TPR	1
8	Databases: PubMed Central/ PsycINFO/Scopus	PMC/PSYC/Scopus	3

Table 2

Distribution of articles among each category

Categories/Type	Total	Articles
Theoretical	15	Alavosius et al. (2017); Gravina et al. (2017); Krispin (2017); Ludwig (2017); Baia and Sampaio (2019); Couto (2019); da Hora and Sampaio (2019); Krispin (2019); Mattaini (2019); Sandaker et al. (2019); Zilio (2019); Busch et al. (2020); Foxall (2020); Niland and Ortu (2020); Pfaller-Sadovsky and Hurtado-Parrado (2020)
Interpretative	10	Baia et al. (2017); Fava and Vasconcelos (2017); Al-Nasser et al. (2019); Ardila Sánchez et al. (2019); Borba (2019); Freitas Lemos et al. (2019); Levy et al. (2019); Malott (2019); Malott and Glenn (2019); Tagliabue and Sandaker (2019)
Experimental	5	Velasco et al. (2017); Soares et al. (2018); Guimarães, Leite, et al. (2019); Guimarães, Picanço, et al. (2019); Soares et al. (2019)
Applied	3	Robertson and Pelaez (2018); Hayashi et al. (2019); Porto and Foxall (2019)

Figure 1

Dispersion of articles in each category by year of publication

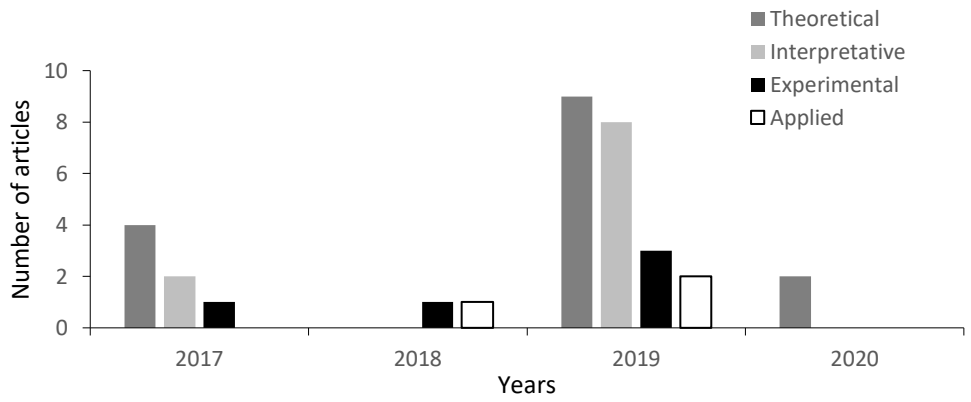
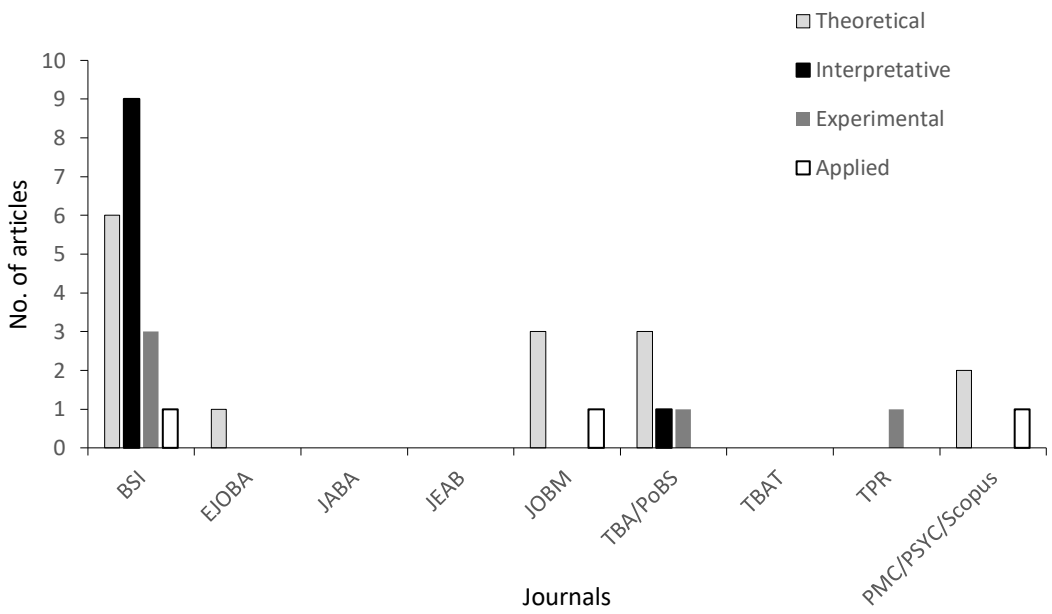


Figure 2

Distribution of articles by category in the reviewed journals and database



Article II

Rule-governed Insensitivity in Groups and Laboratory Microcultures: An Empirical Study

Artikkel II

Regelstyrt Insensitivitet i Grupper og Laboratorie-Mikrokulturer: En Empirisk Studie

Abstract

The purpose of the present study was to investigate the effect of instructions on sensitivity to changes in contingencies in groups and microcultures. Experiment 1 included three groups with three participants each, where in Phase 1 instructions were congruent with contingencies, while in Phase 2 they were not. Thus, sensitivity to changes in the contingency was tested in the second phase. The results of Experiment 1 showed rule-governed insensitivity for one group, while two groups responded in accordance with the changed contingency in Phase 2. Experiment 2 included two microcultures with nine participants each. The experiment started with three participants that stayed throughout Phase 1 (rules and contingencies were congruent) and replacement of participants started in Phase 2. A single participant was replaced every second session. Sensitivity to change in contingency was examined in Phase 2, in addition to transmission of instructions to the new participants. The results showed one microculture responded in accordance with the changed contingency, while the other kept responding in a pattern similar to the instructed pattern of response.

Keywords: rule-governed behavior, instructions, insensitivity, group, microculture

Sammendrag

Formålet med denne studien var å undersøke effekten av instruks på sensitivitet til endringer i kontingensen i grupper og mikrokulturer. Eksperiment 1 involverte tre grupper med tre deltagere hver. I Fase 1 var instruksene kongruente med kontingensene men dette var ikke tilfelle i Fase 2. Sensitiviteten til endringer i kontingensen ble dermed undersøkt i den andre fasen. Resultatene fra Eksperiment 1 viste regelstyrt insensitivitet for en gruppe, mens de to andre gruppene svarte i samsvar med den endrede kontingensen i Fase 2. Eksperiment 2 inkluderte to mikrokulturer med ni deltagere hver. Eksperimentet begynte med tre deltagere som deltok gjennom hele Fase 1 (regler og kontingenser var kongruente) og utbytting av deltagere begynte i Fase 2. En enkelt deltager ble byttet med en annen hver andre økt. Sensitivitet til endret kontingens ble undersøkt i Fase 2, i tillegg til overføring av instrukser til de nye deltagerne. Resultatene viste at en mikrokultur svarte i henhold til den endrede kontingensen, mens den andre mikrokulturen fortsatte å besvare i et mønster som lignet på det instruerte besvarelsesmønsteret.

Nøkkelord: regelstyrt atferd, instrukser, insensitivitet, gruppe, mikrokultur

Culture is composed of cultural practices maintained by its usefulness to the practicing group (Skinner, 1981). The best practices are selected and sustain the culture that the individuals are part of. Culture is a set of contingencies of reinforcement managed by a group through laws and regulations (Skinner, 1976). The foundation of culture is verbal behavior, therefore, rule-governance has exceptional importance in sustaining the contingencies of reinforcement in groups. In behavior analysis, the development of analytic techniques of verbal behavior increased the significance of a third kind of selection by consequences (Skinner, 1981). However, rule-governed behavior has been shown to be insensitive to the changes in the direct contingencies of reinforcement. This indication has direct impact for controlling agencies in a culture, yet contingency insensitivity had been examined only with individuals. The importance of this subject demanded investigation on the effect of rule-governed insensitivity in groups.

Rule-governed behavior

Early research in behavior analysis was mainly conducted with non-human subjects. This approach changed with Skinner's work on a broad analysis of verbal behavior with regard to the basic laws of behavior that came out of non-human research (Vaughan, 1989). Skinner (1957) defined verbal behavior as a mediated process, where the speaker's behavior is reinforced by another person, namely, the listener. Skinner (1953) also discussed conditioning the behavior of the listener and the process of instruction in the book *Science and Human Behavior*. This book was significant for the change of the arguments from a focus on the conditioning processes to an analysis of various classes of behavior, which can be evoked with given conditioning history. All subsequent use of rule-governed behavior was described in terms of evoking behavior under the control of rules. Skinner included analysis of behavior under the control of rules into analysis of other topics. This behavior had not

been addressed independently before his article “An Operant Analysis of Problem Solving” in 1965. That was the first time the behavior was termed “rule-governed” (Vaughan, 1989). Fox and Kyonka (2017) defined a rule as a verbal explanation of environmental contingencies or function-altering stimulus of other stimuli in the environment. In *About Behaviorism,* Skinner (1974) wrote that rules can be learned faster than behavior shaped by direct contingencies, which they describe. In other words, Skinner distinguished rule-governed behavior from contingency-shaped behavior. In addition, Skinner (1984) argued for behavior being not only acquired through natural contingencies, but also through verbal descriptions of them.

Rule-governed behavior, which is determined by verbal antecedents, differs from the properties of contingency-governed or contingency-shaped behavior, which is shaped by consequences. Verbal instructions influence nonverbal and verbal behavior. For example, the instruction “Sit down” is usually followed with motoric behavior, while the instruction “Tell me a story” affects verbal behavior directly (Catania, 2013).

Experimental research on rule-governed insensitivity

The early stage of experimental research on the effect of instructions is marked by two studies. Ayllon and Azrin (1964) were the first to examine instructions in behavior analytic methodology, with patients in a hospital. The results indicated that instructions had a long-term effect only when accompanied by reinforcement. Also, it was found that reinforcement was effective only when accompanied by instructions that specified the consequences. Kaufman et al. (1966) examined the effect of instructions in a more basic research design. The findings indicated that instructions encouraged responding, although the responding was insensitive to the programmed contingencies. Even though the instructions produced insensitivity to the schedule, they nevertheless, assisted appropriate responding.

Baron et al. (1969) found that in the absence of relevant instructions, the actual response to the contingencies was not as precise as when followed by instructions of the contingencies. Weiner (1970) examined the effect of instructions under extinction. Instructions that correctly indicated the maximum number of obtainable reinforcements resulted in few responses during extinction. Extinction responses occurred more frequently with maximum-reinforcement instructions that suggested reinforcements obtainable during extinction. The highest rate of responding during extinction was delivered by the participants who did not receive maximum-reinforcement instructions. Despite the novel knowledge of how instructions influence operant behavior, Hayes et al. (1989) noted a stagnancy in this research topic from the 1970s to 1980s. The function of verbal behavior in human performance became a greater research field after well-known behavior analysts (e.g., Rachlin, Catania, Harzem, and Sidman) started examining it (Hayes et al., 1989).

Matthews et al. (1977) and Shimoff et al. (1981) examined particular responding that resulted from the instructions, which hindered responding to the contingencies of reinforcement. When a participant's responses were shaped, sensitivity to other scheduled contingencies was shown, yet the instructed participants continued to show insensitivity, in spite of the contact with the other contingencies. Furthermore, Catania et al. (1982) investigated the relevance of rule-governed and contingency-shaped responses to both verbal and nonverbal behavior. When the researchers shaped participants' verbal statements in the experiment, instead of instructing them, it resulted in greater sensitivity to the programmed contingencies (Vaughan, 1989). After these initial studies on insensitivity caused by rule-following, numerous studies followed (Baron & Galizio, 1983; Baumann et al., 2009; Fox & Kyonka, 2017; Hackenberg & Joker, 1994; Harte et al., 2017; Hayes, Brownstein, Haas, et al., 1986; Hayes, Brownstein, Zettle, et al., 1986; Joyce & Chase, 1990; Kissi et al., 2018;

Kudadjie-Gyamfi & Rachlin, 2002; Matthews et al., 1985; Newman et al., 1994; Shimoff et al., 1986; Souza et al., 2012).

The present paper focuses on the choice between a progressive and fixed-time schedule when the given instructions match the optimal contingency of reinforcement and a changed progressive-time schedule that is not compatible with the instructions. Fox and Kyonka (2017) and Hackenberg and Joker (1994) have already examined this with single participants.

Hackenberg and Joker (1994) examined whether instructions or a schedule controlled the choices of four participants. Instructions that specified a specific sequence of choosing a blue or red box were given to the participants. The instructions corresponded with the optimal contingency of performance in the initial conditions. The effects of instructional versus schedule control were distinguished with a change of the optimal contingency of performance in the subsequent conditions. Manipulation of the step size of the progressive-time schedule implied incorrect instructions in the latter conditions, taking into account that new instructions were not provided. The results showed control maintained by instructions and reduced sensitivity to schedule changes in the subsequent conditions. A descending sequence of a progressive-time schedule resulted in behavior sensitive to the schedule changes. However, this behavior did not appear systematically with the change of contingencies, thus Hackenberg and Joker (1994) suggested that other factors were involved.

Fox and Kyonka (2017) conducted two experiments where they examined variables that control initial rule-following behavior and rule-following insensitivity. In the first experiment, the participants were given verbal instructions that did not match the optimal performance based on the contingencies of reinforcement in the initial experimental task. In the second experiment, one group was given instructions that differed from the optimal

contingency of performance, while the second group received instructions, which matched the optimal contingency in the first condition of the experiment. After participants' behavior was steady in following the pattern, the contingency was changed and the rule became inaccurate. The results from the two studies indicated that approximately half of participants who started with the inaccurate rule followed it, yet none of them displayed behavior sensitive to the changed contingencies. The participants who started with an accurate rule followed it, yet still, the participants' behavior was insensitive to the changes in the contingencies. Fox and Kyonka (2017) recommended instructions to be minimal in experiments when the instructions are not an independent variable. They also concluded that the findings can be applied in schools and work environment for improving rule-following.

Cultural selection

Besides the interest in rule-governed behavior in experimental research, Skinner sought implications which directly applied to the wider society. Post-war inspired, Skinner (1948) offered a novel on a perfectly advanced society at the utopian level, which was based on rule-governed control, with almost no aversive consequences. In *Science and Human Behavior,* Skinner emphasized different controlling agencies within the culture which depend on verbal conditioning. Vaughan (1989) summarized it as: "Governments, religions, therapists, educators, businesses, and science establish certain rules of conduct (or laws) as techniques of control. These agencies then exercise certain control over individuals by 'specifying the consequences of certain actions which in turn 'rule' behavior'" (p. 103). These agencies were later attributed to the controlling social environment, which Skinner (1974) noted as an important contributor to the mediation of the future. What Skinner referred to as social environment is culture:

> A set of contingencies of reinforcement maintained by a group, possibly formulated in rules and laws, it has clear-cut physical status, a continuing existence beyond the lives of members of the group, a changing pattern as practices are added, discarded, or modified, and, above all power. A culture so defined *controls* the behavior of the members of the group that practices it. (Skinner, 1974, p. 223)

Skinner (1974) further indicated an important feature of culture, namely, the ability to evolve. A cultural practice is described as a possible solution to a problem in a group, which will help it survive, thus, the practice survives together with the group. This implied a process of selection with common properties as natural and operant selection. In *Selection by Consequences* (1981), Skinner already referred to a third kind of selection which involved a different selecting mechanism other than operant selection. Academic debate on cultural selection was initialized and expanded after Glenn (1986) introduced the concept *metacontingency*—a conceptual tool for cultural selection. A distinction is made by Glenn (1988) between the analysis of individual behavior and cultural practices that are formed by behavior of individuals. Cultural practices produce consequences on a group level, and thereby, a corresponding unit of analysis includes behavioral contingencies on a group level. The contingent relation between such interlocking behavioral contingencies and the consequences they produce have been identified as metacontingencies (Glenn, 1988). In metacontingencies, interlocked behavioral contingencies (IBCs) operate as a cohesive unit in the processes of cultural selection (Glenn, 2003). Recurrences of IBCs produce outcomes that are not a sum of the consequences of individual behavior, but rather, the consequence of the interwoven behavior of individuals (Glenn, 2004).

Experimental research on metacontingency

In 2009 the first metacontingency experiment was published, in a peer-reviewed journal. Vichi et al. (2009) investigated the outcome of contingent consequences on patterns of interlocking contingencies of reinforcement. Participants were appointed to two groups, in a reversal design. The participants were asked to bet tokens as an individual behavior, while collectively they chose a row on a matrix with a plus and minus sign. The experimenter announced a column, which determined whether the group won the individual bets. Two conditions followed where the participants distributed their earnings and subsequently gained based on equal or unequal distribution. The results indicated the external contingency of distribution, namely metacontingency, as a selector of the groups' distributions of their earnings. Vichi et al. (2009) concluded that the interwoven behavior of individuals in groups changed as a function of consequences which resulted in the products of those behaviors.

The effect of cultural consequences on variability of IBCs and their aggregate product (AP) was examined by de Carvalho et al. (2017). Pairs of participants worked on a task which imposed coordinated responses for achieving a common goal. The results from the first experiment indicated consistent variation of IBCs among conditions. There was less variability of APs in a condition where meetings were reinforced than in a condition where meeting was not reinforced. The second experiment evaluated stereotypy in IBCs and their APs with participants being exposed longer to the intervention. The results showed total stereotypy of IBCs and AP. The conclusion of de Carvalho et al. (2017) was that the experiments' results implied contingent consequences might have a selective effect on IBCs and their APs.

Soares et al. (2018) examined the effects of verbal and non-verbal consequences on culturants. Additionally, the competition between operant contingencies and

metacontingencies was measured. The participants formed four microcultures with three culturo-behavioral lineages in each. Each microculture had three participants who worked together on a matrix, where they chose between ten rows (1–10) and ten columns (A–J). Different combinations of chosen rows and columns resulted in tokens being won that were later exchanged for money. In two of the microcultures, the experimental design imposed competition between operant contingencies and metacontingencies. The results showed that the target culturant had a more stable rate in the microcultures with no competition. Also, verbal consequences had a selective effect on the target culturants, yet once selected it might be maintained by non-verbal consequences only (Soares et al., 2018).

Soares et al. (2019) further examined concurrency of individual and group contingencies and their effect on the targeted culturant. Moreover, the cultural consequences varied as continuous or intermittent. From four microcultures only two had concurrency between the metacontingency and the operant contingencies. The results showed that microcultures exposed to concurrency did not choose combinations to produce the target culturants, whereas microcultures without concurrency presented selective effects of the cultural consequence on target culturants (Soares et al., 2019).

Guimarães, Leite, et al. (2019) examined the effect of individual punishment and punishment dependent on group performance in laboratory microcultures. The participants chose rows in a colored matrix and consequences were delivered contingent upon individual choices in Experiment 1, while in Experiment 2 consequences were contingent upon the aggregated choice of the three participants in the microculture. The results showed the notable effect of individual punishment on the individual target in Experiment 1. Likewise, in Experiment 2 the results showed the effects of the group-level punishment on the target culturant (Guimarães, Leite, et al., 2019).

Guimarães, Picanço, et al. (2019) expanded the research and measured negative punishment on culturants in a setting with concurrent operant contingencies and metacontingencies. Three different conditions were tested on three microcultures of three participants each. The results showed that negative punishment reduced impulsive culturants (individual consequences) and increased the self-controlled culturant (group consequences).

Metacontingency research has further developed the knowledge of cultural selection and what affects the selecting mechanism. In experimental research, IBCs and their AP are being selected by how significant they are for the group. On the other side, experimental research on contingency insensitivity had been exclusively conducted with individuals alone. Rule-governed behavior is indeed important for culture and the premises by which it operates in the culture. Previous research has reported studies on rule-governed and contingency-governed behavior with individuals, but no studies with groups. Thus, the purpose of the present study was to examine the sensitivity to change of contingencies in groups and microcultures. Two experiments were conducted where instructional versus contingency control was examined. Experiment 1 was conducted with groups, while Experiment 2 involved microcultures—generations with changing members. A mixed-methods approach with quantitative and qualitative components was used in both experiments.

Experiment 1

Experiment 1 was conducted with three groups (G1, G2 and G3) of three participants, nine in total. The groups were exposed to a concurrent PT FT and a concurrent PT PT – a diminishing returns procedure. All three groups were exposed to two phases. In Phase 1 the participants were given verbal instructions that matched the contingency of optimal performance. In Phase 2 the verbal instruction remained unchanged, while the contingency for optimal performance was changed.

To understand the choices made and if the instructed rule controlled them, verbal behavior was analysed. G1, G2 and G3 were video-recorded with available video and audio data. A qualitative analysis included four categories of statements among the participants and anonymous direct quotations. Ethical approval from NSD—The Norwegian Centre for Research Data—was granted before the collection of data.

Method

Participants

In Experiment 1, there were nine participants in total, three in each group. Four female and five male participants, with seven in an age group from 25 to 35 years old, and two participants in an age group from 18 to 24.

All participants signed a consent form. Before participation, they were informed about receiving a gift card after the completed experiment. The participants completed 10–12 experimental sessions for approximately 3 – 4 hours, including breaks and post-experimental debriefing.

Apparatus

Experimental sessions took place in a room that contained desks, chairs, a computer monitor, a big TV screen, three computer mice, a Sony video camera, an external microphone, an HP EliteBook 830G5 laptop and an Asus VivoBook R543UA laptop. All equipment was visible to the participants except the two laptops, which were behind the monitor. The program used in the experiment was designed in Visual Studio 2019® software. HP EliteBook 830G5 laptop was used for running the program and collecting data. Figure 1 displays a graphic presentation of the experimental setting.

Procedure

At the start of the experiment, the participants chose one of the three seats available. At every seat, there was a paper in one of three colours—orange, green and blue. The participants received a color-tag with the identical color of the seat and kept the position until the end of the experiment. The color-tag was used to signal whose turn it was to click the choices on the screen. The background color on the screen automatically changed every 2.5 minutes randomly. Each color was displayed twice per session. The participants sat facing the screen and had a computer mouse for making choices. Every session lasted for 15 minutes and upon ending, a message on the screen appeared that read that the session was over, and experimenters should be called in. At the beginning of the experiment, the participants received written instructions, which were available throughout the first session. They were easily accessible, placed on the desk in front of each participant. Before starting session 2 in Phase 1, the instructions were removed. The instructions were:

INSTRUCTIONS

To begin a choice, click the "Start a new choice" button. You earn points by clicking on the letter icons that appear on the screen. Select one of the two options, "A" or "B" by clicking the letter on the screen. You will take turns using the mouse. When the background color changes, pass the mouse to the participants with matching color. The background color indicates who should perform the clicking on the letters. The group must agree on the choices made.

THE BEST WAY TO EARN POINTS IS TO

SELECT THE FLASHING "A" BUTTON AND

THEN SELECT THE "A" OPTION FOUR MORE

CONSECUTIVE TIMES,

THEN SELECT THE “B” OPTION.

General information

To facilitate the video analysis, we ask you to:

1. Speak clearly, speak one at the time and try not to interrupt each other.

2. During sessions, you should only talk about the experiment. Please do not talk about anything unrelated.

3. During the breaks, we ask that you do not talk about the experiment.

* Each session will last for 15 minutes and then you may have a 2-minute break. Of course, you may leave anytime in the event of an emergency or if you wish to withdraw from the experiment.

After the instructions were removed in Phase 1, no additional instructions were provided. The optimal strategy for earning points was changed from 5A+B in Phase 1, to 1A+B in Phase 2. In other words, the changed contingency for optimal earning of points was not followed by written instructions. At the beginning of each session, a “Start a new session” button appeared. Once it was clicked, a “Start a new choice” button appeared after 7 s. Once it was clicked, it disappeared and two new buttons appeared— “A” and “B,” as available choices for the participants. One point was delivered for choosing either “A” or “B.” A point counter appeared in the upper part of the screen immediately after a choice was made. The counter turned yellow every time a choice was made, and green when a point was received. Options “A” and “B” disappeared when the points were added to the counter. An inter-trial

interval of 7 s was automated in the program between delivering a point and starting a new choice.

In Phase 1, button “A” was set as the PT option and “B” as the FT option. The progressive time started at 0 s and increased by 2 s for each consecutive choice of “A.” Button “A” flashed when it was at 0 s, which signalled no delay in receiving the point. For every upcoming choice of “A,” receiving the point was followed by a delay of 2 s, 4 s, 6 s, 8 s, 10 s, etc. Button “B” was the FT schedule, which was set to 30 s. Therefore, every time “B” was chosen, the point was delivered with 30 s delay. The advantage in pressing “B” was that it reset “A” to its minimum value of 0 s.

In Phase 2, the PT schedule of “A” stayed the same as in Phase 1. Whereas, “B” was changed from the FT to the PT schedule also. It depended on how many “As” were chosen before selecting “B.” Progressive time started at 6 s for “B” and was increased by 1 s for each additional chosen “A.” In the first session the progression was 6 +1 s: 6, 6+7, 13+8, 21+9, 30+10, 40+11, etc. In the next session it was increased by 2: 6, 6+8, 14+10, 24+12, 36+14 etc. In the third following session the progression was increased by 3, in the fourth following session by plus 4 s, and so on with the same criteria. For example, if 3A+B is selected in first session of Phase 2, the delay for “B” would be 21 s. If the same is chosen in the second session of Phase 2, the delay would be 24 s. If “B” is chosen after 3 “As” in the third session of Phase 2, there would be 27 s of delay. The length of “B” was progressing by the number of chosen “A,” as well as consecutive sessions. If there was no “A” chosen before “B,” then “B” is set to be equal to 5A+B. In Phase 2, “B” reset both “A” and “B.”

The number of sessions in the two phases was dependent on two criteria. In Phase 1 a stable median of 5 switch points was required for 3 consecutive sessions for going forward to Phase 2. If the optimal way of earning points was discovered in Phase 2 and lasted for 3

consecutive sessions, then the experiment was finished. Twelve sessions were set as the maximum number of sessions, according to the information given to the participants about the time length in the recruitment process. After the experimental sessions, the participants were asked to complete questionnaires with demographic information. Thereafter, they were debriefed and received gift cards.

The qualitative data in the form of video files were transformed into transcripts. The transcripts secured the privacy and anonymity of the participants. No personal information was revealed, and numbers were used to signify different participants. The data analysis of verbal behavior was coded into four categories: rule-following, rule-breaking, other related and other not related to the task.

Results

Quantitative analysis

Figure 2 shows distribution of switch points and earned points for each group in Experiment 1. For all three groups the instructed strategy of earning points was also the optimal choice in Phase 1. G1 and G2 varied in choice of switch points in the beginning, though rule-following was established. In Phase 2, both G1 and G2 broke the rule and responded in accordance with the optimal contingency. G3 showed a bigger variance in the choice of switch points, yet the rule-following was well established in Phase 1 and continued in Phase 2. The optimal strategy of earning points in Phase 1 (5A+B) provided fewer switch points than the optimal way of earning in Phase 2 (1A+B). That is the reason for the larger displayed section in Figure 2, for the groups that approached the contingency in Phase 2 (G1and G2). An evident difference in the earned points is visible for following the rule versus breaking the instructed rule in Phase 2. G1 and G2 achieved scores above 70, while G3's highest score was 53.

Figure 3 shows the median switch points in each session for G1, G2 and G3. In other words, it shows the median number of times "A" was chosen before choosing "B." All three groups varied in the median switch point in Phase1. G1 had a median switch point of 5 in Sessions 1 and 2, then it increased to 7 in Session 3, and went back to 5 in Sessions 4, 5 and 6. The group followed the rule in 60% of all switch points in Phase 1. The median switch point started with 2 in G2, then it rose to 6 in Session 2. In Sessions 3, 4 and 5 the median was 5. G2 followed the rule in 54.05% of all switch points in the first phase. The most varied choices in Phase 1 had G3. In Session 1, G3 started with a median switch point of 0, as the group chose several consecutive "B's." This trend changed and in Sessions 2 and 3 the median number was 5. In Session 4 it also was 5, although the total choice of "A" before "B" varied, and rule-following had not been established yet. Therefore, Phase 1 continued, with median of 1 in Session 5 and the median number of 5 in Sessions 6, 7 and 8. G3 followed the instructed rule in 62.5 % of all switch points in Phase 1.

Phase 2 revealed even higher variation in choices for G1 and G2, while G3 had a stable choice pattern. G1 started with Phase 2 in the seventh session and continued with a median of 5, which went down to 1 in Session 8. This was the first contact with the contingency, but the group went back to following the rule in Session 9. The median increased to 8 in Session 10, just before it went back to the contingency in Session 11 and followed that in Session 12. Phase 2 started in the sixth session for G2, where the rule was followed. However, the median decreased to one median switch point already in Session 7. The optimal contingency was chosen until Session 10, which was the last for the group. G3 started with Phase 2 later than the other two groups, in Session 10 where the rule-following was already established. G3 continued with the instructed rule in Sessions 11 and 12, which would suggest the group did not contact the contingency of optimal earning in Phase 2. To summarize, G1 and G2 were rule-breakers with followed rule in 13.58% and 4.22%,

respectively, of all switch points in Phase 2. On the other hand, G3 followed the rule with 100% of all switch points in Phase 2.

Qualitative analysis

The verbal behavior of the participants was analyzed on a group level. The participants were asked to agree on the choices made, thus the deciding process involved interlocked behavioral contingencies (IBC) of the three group participants. A made choice was an aggregate product (AP), as well as the earned points. A selecting environment (SE) secured the choices that resulted in a greater sum of earned points. The categorization of the transcripts involved four categories: statements about rule-following, rule-breaking, other statements related to the task and statements not related to the task. The response rate per minute was calculated by dividing the statements by minutes in every session. Figure 4 presents data on the four themes of conversations between the participants. In G1 the largest rate of statements about rule-following (1.67) was in the first session, and complementary to that, there were almost no statements about rule-breaking (0.07). This trend changed in Session 2 and in Session 3 it became opposite: 0.67 for rule-breaking versus 0.47 for rule-following. Moreover, there were more statements about things related to the task with a response rate of 7.60 and 7 in these two sessions. G1 counted the length of "B" in seconds, as early as in Session 2. Then the group decided to "go for more As" in Session 3 as that would result in more points. In Session 4, 5 and 6 the statements for rule following increased and for rule-breaking decreased, as the participants went back to following the instructions. Statements about things related to the task dropped from 3.53 in Session 4 to 0.47 in Session 6. Interestingly, there was a low rate of irrelevant statements until Session 4, and a significant increase in Session 5 and 6. In Session 5 they started to talk about private things, ask each other questions that were of no relevance to the task. Following the instructions seemed

automated and the participants sometimes asked each other about the number of "As" chosen. The same tendency continued in Session 6 as the participants started to become bored. One of them said "I can't make my brain, like, care about… for, like, so long. Because this is, like, very simple," which identified boredom as a confounding variable. As the next phase started, G1 increased the discussion on both rule-breaking (1, 2.13) and rule-following (0.47, 1.27) in Sessions 7 and 8 respectively. Statements that were relevant to the task also increased, while irrelevant ones decreased to 0 in Session 8. This result was likely, because of the first contact with the contingency. An increased score (AP) in a short time made G1 change the strategy and they went on choosing "flash–B, flash–B" (contingency of optimal earning), until "B without flash" was decided. As the group chose the "B" option twice, they had to wait for 30 s. This resulted in G1 deciding to go back to the instructed rule and counting how many points were earned per minute. In Session 9, the group decided to follow the rule again, which continued in Session 10. However, the number of times "A" was chosen increased as G1 counted the time and concluded it as more efficient way of earning points. The length of "B" was increased in each consecutive session after the chosen "As," which was noticed by one of the participants: "maybe these sessions are different than those." G1 reconsidered their strategy in accordance with the earned score and decided on choosing 1A+B again. A significantly increased score in Session 11 resulted in selecting the same strategy in Session 12.

The graph of G2 in Figure 4 indicates that the group in general talked less than G1, as the number of minutes per session were equal across the groups. G2 had a relatively high response rate in both rule-following (0.93) and rule-breaking (0.87) in the first session, yet other statements related to the task were highest at 6.73 per minute. In Session 2 rule-breaking statements peaked (1.33), while rule-following decreased to 0.53. The other-related category decreased to 5.20 in Session 2 and stayed around 5 statements per minute in

Sessions 4 and 5. Both statements on rule-following and -breaking reduced to almost 0 in Session 3, and had slight increase in Session 4, but still under 0.5 per minute. G2 started to follow the instructed rule in Session 3, which continued in Sessions 4 and 5. Statements on rule following and rule breaking were 0 in Session 5, while statements related to the task increased to 2 per minute. The participants started to talk about things irrelevant to the task, as well. This was not a surprising result as already in Session 3 there was statement like "So we are going to keep doing that through the whole session? That's kind of boring." This again points out a confounding variable that probably have affected the rule-following. At the beginning of Session 4, one participant suggested pressing 30A+B, based on the assumption that every chosen A adds one or two seconds only. Another participant then explained the interval of 7 s. between choosing and receiving the point, which was agreed on by the third participant. The interlocking behaviors of the three participants here resulted in choosing the instructed strategy, which was also the optimal outcome. In Session 6, statements on rule-following and -breaking were both 0, while other, related statements were 1.60 per minute and non-related statements, 0.93 per minute. The participants expressed their dissatisfaction with doing the same task again, and mainly followed the instructed rule. The communication was minimal with periods of no talking. Phase 2 started in Session 7, where statements about rule-following or -breaking were below 0.5 per minute, while statements related to the task increased to 5.93 per minute. One of the participants insisted on choosing more "As," as "B" got longer. G2 tested this with counting the seconds after several pressed "As" and concluded that "B" did indeed get longer. In the next step, G2 chose 1A+B. This strategy resulted in an increased number of points (AP) and was chosen until the end of the session (SE). In Session 8, rule-following and rule-breaking statements were 0 and 0.13, respectively, while statements related and not related to the task were 1.13 and 0.87 statements per minute. The conversation decreased significantly, and the main theme was how many points could be

earned. As expected, G2 continued choosing the contingency of optimal earning (SE) in Sessions 9 and 10 as well. The communication was minimal in the two sessions as a result of already agreed choice strategy. Session 10 was the third session with steady-chosen contingency for G2, therefore it was last session for the group.

The graph of G3 in Figure 4 indicates that this group talked least, compared to G1 and G2. In Session 1 the participants talked slightly about rule-following (0.80) and rule-breaking (0.47), mostly about things related to the task with 5.73 statements per minute. The participants talked about the instructions, repeated them, decided on how to choose and what has already been clicked. G3 followed the instructions in the beginning and surprisingly changed the strategy of breaking the instructed rule towards the end of Session 1. In Session 2, the participants rarely talked about following or breaking the rules, at 0.13 and 0.07 statements per minute, respectively. Still, statements related to the task remained with 4.67 per minute. This was not surprising, as G3 followed the rule sometimes and also tested strategy with choosing several consecutive "As." In session 3 there were not any discussions on rule-following or rule-breaking, just on related things with 2.33 statements per minute. Despite the missing discussion, G3 chose a strategy of rule-following, which became automatic. Conversations irrelevant to the task arose among the participants. In Session 4 there was a slight increase in rule-following and rule-breaking discussions with 0.27 and 0.40 statements per minute, respectively. The discussion about other things was low as well. Some of the statements in the rule-breaking category included "Let's try just pressing A every time" and "Let's see how many points we get. The next round we can try just pressing B G3 decided on using the suggested strategy of pressing only "A," which implied insufficient stability in rule-following. Session 5 continued with a similar trend. Statements on rule-breaking were 0.6 per minute, while other, related statements were 0.80 per minute and not related 1.47 per minute. G3's choice strategy in this session was 1A+B. Other statements

were directed toward the purpose of the task and participants' opinion on that matter. In the beginning of Session 6, G3 decided on earning 50 points and following the instructed rule. After testing different strategies to maximize the aggregate product, G3 went back to the instructed rule which had provided highest score. In other words, the selected strategy was optimal (SE) and was agreed upon again (IBC) because it resulted in more points (AP). G3 followed the instructed rule in Session 7, as well. The participants had already determined on choosing 5A+B, therefore there was no discussion, except questions about time. Likewise, choices in Session 8 were mechanical—5A+B without discussion. However, the participants argued about the waiting time between the choices. Session 9 was equally automated as the previous three sessions and there was no discussion. Phase 2 started in Session 10, where G3 selected a new strategy: one sequence with 5A+B and just waited until the end of the session. Surprisingly, the participants increased verbal behavior, although it involved other related (4.87) and non-related (4.47) statements per minute. G3 went back to mechanically choosing 5A+B with no discussion on following the rule or not. However, in Session 12 one of the participants suggested that the lower amount of earned points in Session 11 was related to what they did in Session 10. The group also discussed the longer waiting time after pressing "A," though they kept the same strategy. Session 12 was the last, hence G3 did not contact the optimal contingency for earning points.

Discussion

In Experiment 1, all three groups were given instructions that corresponded with the optimal contingency of performance in Phase 1, while the instruction no longer matched the optimal contingency in Phase 2. The best strategy to earn points in Phase 1 was by choosing 5A+B. In Phase 2, the optimal contingency of performance was achieved by choosing 1A+B. G1 and G2 generally followed the rule in Phase 1 and, in addition, tested strategies similar to

the rule. However, G1 and G2 were not under instructional control throughout Phase 2. In contrast, G3 had variable rule-following in Phase 1 and rule-governed choices in Phase 2. These results are not completely consistent with previous research done with individuals (Fox & Kyonka, 2017; Fox & Pietras, 2013; Hackenberg & Joker, 1994) although the analysis of the qualitative data confirms the finding of Fox and Kyonka (2017) about between-subjects differences in terms of instructional control. Interestingly, some of the participants exhibited an aversion to breaking the rule, even when they earned more points by not following it. Nevertheless, the analysis of verbal behavior suggests that the groups were both under the control of contingency and instructions in Phase 1. This might be an implication of the interlocked behaviors of the participants in the group, as different strategies and assumptions were provided by the participants and usually the most rewarding was selected. In Phase 2, expanded discussion and cooperation between the participants resulted in optimal performance in G1 and G2, while G3 was missing this component.

Experiment 2

Experiment 2 included two microcultures—MC1 and MC2. Both microcultures started with three participants in each. The same three participants stayed for the first six sessions, then from Session 7 a participant was replaced with a new one every two sessions. MC1 and MC2 had 18 sessions each, which was a planned experimental design. There were nine participants per experiment, giving eighteen participants in total. The two MCs were exposed to two phases. In Phase 1 the participants were given verbal instruction that matched the contingency of optimal performance. In Phase 2 the verbal instruction remained unchanged, while the contingency for optimal performance was changed, making the instruction inaccurate according to the contingency in force.

Qualitative data was collected in Experiment 2. The same equipment and form were used – video recorded sessions with available video and audio data. Besides the understanding of verbal behavior that followed the choices which participants made as a group, the element of ceremonial and technological control was analyzed throughout the overlapping generations. The Norwegian Centre for Research Data (NSD) had approved the study prior to collection of data, and storage followed their rules and requirements.

Method

Participants

Eighteen participants took part in Experiment 2, nine in each MC. Seven of them were female and eleven were male. Fourteen participants were in the age group from 25 to 35 years old, while four were in the group 24 or younger. All participants were told about receiving a gift card for completed experimental sessions, prior to participation. From the nine participants per MC, five participants stayed for six sessions. One participant stayed for eight sessions, one participant stayed for 10 sessions, one participant stayed for four sessions and one participant stayed for two sessions. Participants stayed the same number of sessions in MC1 and MC2. Prior to participation, all participants signed a consent form.

Apparatus

Experimental trials took place in a room with three desks, three chairs, a computer monitor, a big TV screen, three computer mice, a Sony video camera, an external microphone, and two HP EliteBook 830G5 laptops. The same software as described in Experiment 1 was used for collecting and saving data.

Procedure

The beginning and Phase 1 of Experiment 2 had the procedure as deployed in Experiment 1. In Phase 2, the PT schedule of "A" stayed the same as in Phase 1. However, the fixed time of "B" was changed to the progressive schedule. Again, the progression of "B" was dependent on how many "As" were pressed beforehand. In this experiment "B" had the same PT schedule across the sessions in Phase 2. Six seconds was the starting PT value, and for every next chosen "A," it was increasing for 6 s. Namely, if 3A+B is chosen in the first session of Phase 2, the delay time for "B" would be 18 s. If the same was chosen in the second session of Phase 2, the delay would also be 18 s. If there was not any "A" chosen before "B," then "B" would have a delay of 30 s.

The same instructions were used as in Experiment 1. The only difference was that the paper with instructions was available for three sessions in this experiment. The purpose was to establish rule-following that would be transferred to the new participants. The first new participant was changed in Session 7, which, at the same time, was the first session in Phase 2. The contingency for optimal earning of points was changed to 1A+B. From Session 7, a participant was changed every second session (i.e., 9, 11, 13, 15, 17). The total number of sessions was set at 18, with intention for reaching three totally new generations of participants, which involved seven overlapping generations.

After a participant completed the assigned number of experimental sessions, the participant was asked to complete a questionnaire with demographic information. The participant was then debriefed and received a gift card.

Qualitative data in the form of video files were transformed into transcripts. The same rule for privacy and anonymity of the participants was followed. No personal information was revealed, and numbers were used to signify different participants, with the exception of

when the participants talk about themselves and share personal information with the other participants. The same strategy for analyzing verbal behavior was used with the four categories: rule-following, rule-breaking, other related and other not related to the task. In addition, transmission of instruction to the new participant was analyzed as ceremonial or technological contingencies.

Results

Quantitative analysis

Figure 5 shows distribution of switch points and earned points for the two microcultures in Experiment 2. The two MCs had same number of sessions in Phase 1 and Phase 2. The instructed strategy of earning points was also the optimal (grey shadow) in Phase 1 for both MCs. MC1 varied slightly in choice of switch points in this phase. It started with following the instructed rule (5A+B) and had a small deviance from it in one of the sessions where 6A+B was tested. Most of the switch points of MC2 are in accordance with the instructed rule. Figure 5 depicts evident differences in the choice of switch points between MC1 and MC2. The majority of switch points in MC2 matched the optimal contingency (1A+B) in Phase 2, while MC1's choice of switch points was closer to the instructed rule. MC1 achieved the highest score of 58, whereas MC2's highest score was 78.

Figure 6 displays the median switch points in each session for MC1 and MC2. In other words, it shows the median number of choosing "A" before choosing "B." Both microcultures varied in the median switch point in Phase1. MC1 had a median switch point of 5 in Session 1 and 2, while MC2 had median switch point of 4.5 in Session 1 and 2.5 in Session 2. In Sessions 3 and 4, MC1 increased the median to 6, whereas MC2 matched the instructed rule with a median of 5. Both microcultures had a median of 5 in Session 5, which

continued in Session 6 for MC1, though it decreased to 0 for MC2. The rule was followed in 72.09% and 78.05% of all switch points in Phase 1 in MC1 and MC2, respectively.

Phase 2 illustrates dissimilar choice patterns in MC1 and MC2. In MC1 median switch points varied between 4 and 5 in Sessions 7 and 8, followed by a drop to 0 in Session 12. The median switch point was back to 4 in Session 13, raised to 5 in Session 14, it went back to 4 in Session 15 and stayed stable until the last session. The optimal contingency was not discovered by MC1. MC2 started with a median switch point of 6 in Session 7 and gradually went to 5 in Session 8 and to 4 in Session 10. In Session 12 the median switch point decreased to 1, where the contingency for optimal earning was discovered. The median number remained 1 until the end of the experiment. To summarize, in MC1 were chosen switch points close to the rule, where 20.49% of all switch points in Phase 2 were following the instructed rule. On the other hand, in MC2 the rule was chosen in 6.57% of all switch points in Phase 2.

Qualitative analysis

The verbal behavior of the participants was analyzed on a group level, within seven overlapping generations. The categorization of transcripts included four categories: statements about rule-following, rule-breaking, other statements related to the task and statements not related to the task. The response rate was calculated by dividing the number of statements by minutes in every session.

Figure 7 presents data on the four themes of discourse between the participants in each generation in MC1. The first generation started with three participants (P1, P2 and P3) who stayed the same throughout Phase 1. In Session 1 there was no discussion on rule-breaking, just rule-following with a response rate of 2.60 statements per minute. Other statements, related to the task, dominated with 6.47 per minute. The participants were

generally talking about who should click, discussed the instructions and counted the number of chosen "As." In Session 2 they kept choosing the instructed rule, although one of the participants suggested: "So, what I'm thinking is, if we're all up to change the strategy, like the clicking rules sometimes, maybe we can change at the beginning of next round?" This statement brought discussion on what could be tried, therefore, the statements of rule-breaking increased to 0.93 per minute, while rule-following decreased to 1.73. In contrast, Session 3 involved almost no statements (0.07) about the instructed rule, whereas rule-breaking statements rose to 2.13 per minute. The participants examined the effect of choosing "A" consequently, without choosing "B." The discussion about other, related subjects prevailed in the conversation, and one of the participants concluded "Maybe the last one has to not be B. Because B takes more time to register as a point. And it doesn't matter..." This became an established rule by the group and was used in the subsequent sessions. In this session, one of the participants noticed that "A" was flashing only after a chosen "B" and suggested choosing 1A+B. This strategy was tried, although it was not further selected because of the reinforcing power of the 2–3 fast "As" after a chosen "B." In Session 4 there was a similar trend with low discourse about following the instructed rule, while 1.6 statements per minute were about breaking the rule and 5.78 statements related to the task. One of the participants commented: "I'm also thinking, like, should we take five consecutive As or six As before clicking the B? Because I still think A would be faster than the B, so maybe there's still some space we can improve..." which resulted in the strategy of choosing 6A+B. In Session 5, conversation on rule-breaking decreased to 0.13, and rule-following increased to 1.13 statements per minute. Calculations on the waiting time after a different number of chosen "As" before a "B" resulted in going back to the instructed rule. This continued in Session 6, where the generation concentrated on choosing the correct number of consecutive "As." Interestingly, the rate of non-related topics was very low. The participants

discussed the choice strategies (IBCs) and selected the most rewarding strategy (SE), which produced a higher number of points (AP). Phase 2 started in Session 7, as well as the change of participants. To illustrate, P1 left and a new participant (P4) took the place in the second generation (P4, P2, P3). Thus, the following generations always had three participants, where one was new. P3 informed P4 about the rules based on technological contingencies, the instructed rule was the best by their own experience and an explanation followed on what else was tried. The second generation followed the instructions in Session 7 and discussed them with 2.27 statements per minute. The conversation was also directed towards matters related to the task with 9.40 statements per minute. This included the transmission of the instructed rule to the new participant with the addition of rules discovered in the first generation. The new participant suggested choosing fewer "As," therefore 4A+B was tested in Session 8. There was one statement per minute on rule-following and rule-breaking, while discourse on related subjects was 7.28 statements per minute. P2 left and a third generation was formed (P4, P5, P3). The transmission of the rules was done by the member that had stayed longest in the experiment—P3, with additional information from P4. Instructing the new participants involved technological contingencies and a detailed explanation of what the previous two generations found to be the best strategy. However, a paradoxical situation occurred where P3 explains that "B" has fixed time and it was counted. That was true in Phase 1 but had changed in Phase 2, thus the choices of the generation became a ceremonial metacontingency. Session 9 continued the choice of 4A+B and choosing only A toward the end of the session. There were some statements about rule-following and more on rule-breaking. However, discourse about non-related subjects increased significantly (3.87). Conversation on other themes decreased in Session 10, where the generation chose to follow the instructed rule again. That decision was a product of the ceremonial control, as P3 and P4 decided that going back to the instructed rule would be better, even though they did not

explain why. In Session 11, P3 was changed with P6 and fourth generation (P4, P5, P6) was formed as a whole new generation. The "oldest" member of the generation started instructing P6 about what they have been doing. The description of the task included technological and ceremonial contingencies, as some practices were clarified through their usefulness, while other were just transmitted because it was done before. Session 11 was characterized by 1.40 statements per minute on rule-breaking and 9.67 statements per minute related to the task. An example of the ceremonial control in the fourth generation was the choice of strategy 4A+B, simply because it had worked better in the previous generation. In Session 12 there was a similar trend of discourse, with reduction in the conversation generally. In this session, the generation chose to try something new and the strategy was choosing only "B." Session 13 joined participant P7 and the fifth generation (P7, P5, P6) was formed. The "oldest" member in the generation—P5 started to instruct P7 and P6 added some comments. Interestingly, rules or instructions were no longer mentioned. Statements about rule-following or rule-breaking were both under 1 per minute, while statements related to the task (4.20) and not related (3.33) were dominant. The transmissions of knowledge to the new participant was under ceremonial contingencies, as the task was described and 4A+B was supplemented as a strategy the generation used and should use further. There was no explanation on the length of waiting time, or why it was chosen strategy. The participants discussed fast clicking and the highest score from the previous sessions. The choice strategy of the fifth generation emerged as ceremonial metacontingency, where the members chose together the same sequence several times (IBCs), for even higher score to be achieved (AP). Ceremonial control continued in Session 14, where P5 suggested the strategy 5A+B and explained: "Actually, the first group was told that the most efficient way is 5 and 1." Discussion on following the instructed rule was raised, although statements related to the task prevailed with 4.13 statements per minute. The sixth generation (P7, P8, P6) was composed when P5 left and a

new participant (P8) joined in Session 15. Once again, the "oldest" member of this generation—P6, instructed P8. A description of the task was given and 4A+B was recognized as the best choice strategy, and therefore suggested for further choice. There was no discussion on rule-following, and rule-breaking was rarely discussed, at less than 0.5 statement per minute. As a result of diminished original instructions, this trend continued in Sessions 16, 17 and 18. In Session 16, the same choice strategy was selected and was not further discussed, thus, the discourse was directed toward subjects not related to the task. The seventh generation (P7, P8, P9) was formed in Session 17, with a change of P6 with P9. This was a third whole new generation. P7 and P8 instructed P9 together, where most of the information was a description of the task and choice strategy 4A+B. However, P9's behavior involved technological contingencies, questioned choice strategy and questioned the functional relation of choosing more consecutive "As." This resulted in a sequence of choosing 8A+B. In Session 18, the generation went back to the strategy 4A+B due to the lower number of points earned in the previous session.

Figure 8 presents data on the four themes of discourse between the participants in each generation in MC2. The first generation started with three participants (P10, P11 and P12) who stayed throughout Phase 1. In Session 1 rule-following was discussed with 2.20 statements per minute, while rule-breaking followed with a rate of 1.33 statements per minute. Conversation on subjects related to the task prevailed with 13.93 statements per minute. In Session 2, there was almost no discussion on rule-following and also low on rule-breaking with 1.93 statements per minute. Statements related to the task were still relatively high at 6.60 per minute. The generation followed the instructed rule in three sequences, then tried different strategies, for example choosing only "A" or "B." In Session 3, rule-breaking was not discussed, while rule-following statements increased to 0.53 per minute. 2.03 statements per minute were not related to the task, yet the main discussion included

statements related to the task at 5.73 per minute. This involved questions about the number of pressed “As” and discussion on the choice strategy in the previous session that resulted in fewer earned points (AP). Therefore, the generation chose to follow the rule in Session 3. In Session 4, the instructed rule was chosen again (SE), as a result of an increase in the sum of points. Rule-breaking and -following were not discussed and generally the discourse was minimal, as shown in Figure 8. The same trend with minimal discussion followed in Session 5. In the beginning of the session, the participants discussed what strategy should be used (IBCs) and elected to follow the instructed rule again, for the reason that the earned points increased (AP). However, the generation did not earn more points in Session 5, and thereby changed the strategy in Session 6 to choosing only “A.” The general discourse was on non-related subjects throughout the session with 7.73 statements per minute. Phase 2 started in Session 7, and the second generation (P13, P11, P12) was formed with a change of P10 with P13. The new participant was instructed to follow the rule 5A+B, with the explanation that it was stated in the official instructions. This is visible in the response rate where rule-following discussion increased to 1.13 statements per minute. Statements related to the task also increased to 9.40 per minute, also statements not related to the task increased to 4.47 per minute. P11 and P12 expressed their dissatisfaction with the length of participation and repetition. In Session 8, the generation discussed briefly and agreed to follow the instructed rule again. The main theme of conversation was how many “As” were chosen with 8.86 statements per minute. In Session 9, P11 was replaced with P14, thereby a third generation (P13, P14, P12) was formed. Interestingly, P13 started with the transmission of the instructed rule, although P12 explained it in more detail. Technological contingencies were involved in the interpretation of the rule with the additional information that the new member can try other strategy, even though 5A+B had worked best in the previous sessions. There were 1.27 statements on rule-following in Session 9, followed by 6.47 statements per minute related to

the task. Most of the conversations were directed towards the chosen "As" and what have been tried before. P14 asked about the consequence of choosing fewer than five "As," which was not tried, therefore it became the chosen strategy in Session 10. There was no discussion about the instructed rule, while 0.53 statements per minute were about breaking the rule. Still, statements related to the task dominated at 6.20 per minute. The technological metacontingency was sustained as the participants discussed that choosing five "As" should be compared with choosing four "As" before a "B." Later in Session 10, the participants discussed further (IBCs) and concluded that 4A+B resulted in more points (AP). Consequently, this was the selected strategy for the following session. In Session 11, the fourth generation (P13, P14, P15) was formed as a whole new generation. The "oldest" member in the generation explained to P15 about the previous participants who received instructions about choosing 5A+B, which was tested, as well as 4A+B. Ceremonial control was involved, as P15 was told that the strategy for the current session should be 4A+B. Statements related to the task dominated in Session 11 at12.87 per minute. This category included conversations about the waiting time between chosen options, previous choice strategies, the meaning of colors, etc. However, P15 demonstrated behavior under technological contingency and suggested choosing 3A+B. The generation decided this to be tried in the next session, thus, points can be compared with the earned points from previous sessions. In Session 12, statements related to the task prevailed at 12.40 per minute and discussion on rule-breaking increased to 2.93 statements per minute. Session 12 started by discussing choice strategy 3A+B, yet P15 did not agree and suggested another strategy: 1A+B. The other participants agreed as this strategy had not been tested. First, "B" was chosen four consecutive times, then the optimal contingency 1A+B. Alternatively, 2A+B was tried, though 1A+B was chosen throughout the session. The fifth generation (P16, P14, P15) was formed in Session 13 with the substitution of P13 with P16. The new participant was

informed about the original instructed rule, 5A+B, then the strategy 1A+B was explained as being most effective. The new participant was encouraged to propose other choice strategies, which implied technological control. Clarification of the task, meaning of colors, discussion on the previously chosen strategy made statements related to the task ranked highest, 16.13 per minute, although non-related themes contributed with 5.27 statements per minute. The same trend of discussion continued in Session 14. Technological control was exemplified again as the generation decided to choose randomly and select the strategy that works best. 3A+B, 2A+B, 8A+B was tried (IBCs) before 1A+B was selected again as the strategy that resulted in more points (AP). In Session 15, P14 was changed with P17, thus, a sixth generation (P16, P17, P15) was formed. Information on the choice strategy 1A+B was presented to P17, who did not understand the point with the task. The instructed rule was not mentioned. Thereby, a longer description followed on what had been done before and the new member was offered the chance to suggest new strategies. As a result of this, statements on rule-following or -breaking diminished, while related statements prevailed with 13.60 per minute. In Session 16, technological metacontingency sustained the choice of 1A+B which had increased the AP. Themes not related to the task were mainly discussed in Session 16, at 10.93 statements per minute. A whole new generation was formed in Session 17, which presented the seventh generation (P16, P17, P18). P17 was informed about the choice of strategy 1A+B and the goal of the generation to win as many points as possible. The conversation was directed towards what was chosen, what was the difference between choosing 1A+B or 4A+B, which resulted in 15 statements per minute on subjects related to the task. Surprisingly, there was no discourse on unrelated subjects. The same trend continued in Session 18, where 1A+B was chosen exclusively.

Discussion

In Experiment 2, both microcultures received instructions that corresponded with the optimal contingency of performance in Phase 1, while the instruction no longer matched optimal contingency in Phase 2. The change of participants started in Phase 2, where, in every second session an overlapping generation was formed. Both microcultures had seven overlapping generations. MC1 followed the rule in Phase 1, though responses in Phase 2 were not sensitive to the changed contingency of reinforcement. In Phase 2, MC1 responded with the choice strategy 4A+B, which was very similar to the instructed 5A+B. On the other hand, MC2 followed the rule in the initial phase, but was sensitive to the changed contingency in Phase 2. These findings are in contrast to the previously reported studies with individuals (Fox & Kyonka, 2017; Fox & Pietras, 2013; Hackenberg & Joker, 1994). The present results indicate that the instructed rule was not followed in Phase 2, whereas previous findings show rule-governed insensitivity in the subsequent phase. The analysis of verbal behavior indicated transmission of instructions under technological contingencies in the second, third and fourth generations. The fourth generation started to be under ceremonial control, which continued in generations 5, 6 and 7. The instructed rule was last mentioned in the fifth generation. An interesting finding is the predominance of seniority leadership in MC1. The “oldest” member in generations 3, 4, 5 and 6 tended to instruct the new member about the task and rules, which is consistent with previous results (Insko et al., 1983; Insko et al., 1982). MC2 showed seniority leadership only in the fourth generation. The transmission of instructions was also different from MC1. Generally, the generations in MC2 were under technological control as new participants received information on the choice strategies and why those were selected. Also, new members were encouraged to suggest other choice strategies. However, both MCs selected a choice strategy that was better than the instructed one. A possible explanation for MC1’s lack of contact with the optimal contingency are the ceremonial metacontingencies

through generations 4 to 7. Contrarily, technological metacontingencies in MC2 are a possible cause of varied choices that resulted in selecting the most rewarding contingency.

General discussion

The present study examined sensitivity to a contingency change in groups and microcultures. In Experiment 1, the general trend in Phase 1 was rule-following with relative variation. In Phase 2, G1 and G2 were sensitive to the changed contingency, while G3 responded under instructional control. In Experiment 2, both microcultures displayed a trend of rule-following in Phase 1. MC1 continued with a choice trend similar to the instructed, with a moderation in the choice strategy. Whereas MC2 contacted the optimal contingency of performance. With the majority of the groups and half of the microcultures responding in accordance with the optimal contingency, these results have not confirmed previous research (Fox & Kyonka, 2017; Fox & Pietras, 2013; Hackenberg & Joker, 1994) on rule-governed insensitivity with individuals. Previous findings indicate rule-governed insensitivity in the subsequent phase with changed optimal contingency. The analysis of verbal behavior indicated that the participants' interlocked behaviors were directed toward finding the optimal contingency of reinforcement. For instance, G1 and MC1 counted the PT time and calculated that the instructed rule is optimal for earning most points in Phase 1. G2 and MC2 had a similar technique in deciding to follow the rule in Phase 1. G3 tried different choice strategies, but the selection of AP was not done systematically, which implies the groups was more under the control of the rule than the contingency. In Phase 2, G1 and G2 were gradually downsizing the number of chosen "As" from 5A+B to 3A+B to 2A+B to 1A+B, which resulted in selecting the AP that gained most points. MC2 had a similar trend, although the deduction for choosing fewer "As" was more direct. This outcome can be described as a technological metacontingency, because the transmission of the group practices was under

technological contingencies and variability in choices was encouraged. However, the most interesting finding comes from the transmission of instructions in MC1. The choice strategy 4A+B was tested in the fourth generation and resulted in more points than choosing 5A+B, whereby it was selected as the best strategy. Moreover, it was further transmitted as a rule to the new participants, which resulted in subsequent generations opting to follow it. In other words, the initially instructed rule was substituted with one the group made. This outcome can be described as a ceremonial metacontingency, as the new rule was transmitted and followed without large variability in the choices. An additional difference between the groups that contacted the optimal contingency and the groups that showed insensitivity was in the extent of communication. The groups that responded in accordance with the optimal contingency also had greater discussions on subjects related to the task.

The present study is preliminary in investigating rule-governed insensitivity within groups and laboratory microcultures. Previously reported literature includes studies where contingency sensitivity is exclusively tested with individuals. The implications from these studies are valuable in application on individual level, but their generalizability to groups has not been tested. The present results imply that groups might be more successful in responding to the changes in contingencies than individuals. Jacobs and Campbell (1961) were among the first to examine the preservation of an arbitrary tradition through several generations in laboratory microcultures. However, the study included autokinetic judgement as a cultural norm, thus there was no change in underlying contingencies. The study concludes that the arbitrary norm diminished after several generations and a natural norm was established. An analogy can be made of instructions as an arbitrary norm, while the contingency of optimal performance evidences as a natural norm. The present study shows consistent finding in the diminished instructions in the groups that selected the optimal contingency. Similar studies focused on social power and seniority in experiments with generations (Insko et al., 1983;

Insko et al., 1982; Nielsen & Miller, 1997). The results implied greater perceived social power of the participants who had stayed longest in the generations. This is consistent with the behavior displayed in MC1, where the senior member instructed the new participant in the third, fourth, fifth and sixth generations.

A study conducted by Baum et al. (2004) examined both rule-governance and cultural evolution in laboratory microcultures. Traditions of rule-giving included introducing the new participants with the task through accurate instructions, inaccurate (mythological) rules and coercion. The categories of rule-following and rule-breaking in the analysis of verbal behavior in the present study are somewhat similar to the traditions of accurate and inaccurate transmission of rule. Baum et al. (2004) found that the groups maintained a choice tradition that enabled maximization of the earnings. Similarly, in the present study, the groups selected the choice strategy that resulted in the highest score, and transmitted the instructions about that choice to the newcomers. Baum et al. (2004) refer to this as evolution in the norms in the microsocieties. Metacontingency research usually has a standpoint in examination of behavior that results in changed cultural practices. In other words, metacontingency is used as a conceptual tool in cultural selection research, which commonly involves microcultures. Nevertheless, reported literature on metacontingency has not included rule-governed insensitivity. This overlooked field might have significant implications for behavioral research within a selectionist perspective. The modest results of the current study indicate that future empirical studies should investigate rule-governed insensitivity within groups and microcultures in an extended manner.

This is just an introductory study which explored rule-governed sensitivity within groups and laboratory microcultures and has some limitations. The participants were chosen based on their interest in joining the study and they varied in their learning histories in terms

of previous participation in experiments. Additionally, some participants engaged slightly in discussion of choice strategy, which likely had an impact on the group dynamics and the demonstrated verbal behavior. Despite this, boredom was mentioned several times by the participants and is likely to have impacted the interest in performing the required experimental task. In some of the groups, it was noticed that the participants engaged in socially reinforcing behaviors, for example talking about private matters, which was not relevant to the experiment. In such cases, the participants' verbal behavior did not match the choices made. For instance, the participants said they would follow the instructions, when they actually did not because they did not count how many "As" had been pressed. Another limitation is a software issue that occurred during the change of experimental phase, which prolonged Phase 1 with one session more. Hence, G3 went through nine instead of eight sessions in Phase 1.

Despite the limitations, the current study provides some practical implications. First, rule-governed behavior has been acknowledged as an important tool for controlling agencies that create social and cultural practices. As the contingencies change in the social environment, the instructional control should follow that change. A practical example is a change in the world climate that has large negative consequences, yet people's behavior is still under instructional control of the governmental policies. Moreover, companies, schools and different types of organization might improve group performance with instructions that match the natural contingencies of reinforcement. Broader knowledge on this matter is needed for direct application, therefore, future studies should investigate the effect of correct versus incorrect instructions. Another matter that should be further investigated is the effect of reinforcement on rule-following or contingency responding. Also, verbal behavior should be analyzed more systematically, as new variables that sustain rule-governed behavior might

occur in groups, for example, social pressure. Moreover, concurrency between individual contingencies and metacontingencies in means of rule-following should be examined.

In conclusion, rule-governed behavior is of great importance for culture and its development. The results of the present study showed that the majority of the groups and half of the microcultures were sensitive to the change in contingencies for optimal performance. The transmission of the group practices in the microcultures involved technological and ceremonial contingencies. This is a preliminary study that examined rule-governed insensitivity in groups and microcultures, therefore conclusions should be reviewed with caution, and further research should expand on the manipulated variables in the studies.

References

Ayllon, T., & Azrin, N. H. (1964). Reinforcement and Instructions With Mental Patients. *Journal of the Experimental Analysis of Behavior, 7*(4), 327-331. https://doi.org/10.1901/jeab.1964.7-327

Baron, A., & Galizio, M. (1983). Instructional control of human operant behavior. *The Psychological Record, 33*(4), 495-520.

Baron, A., Kaufman, A., & Stauber, K. A. (1969). Effects of Instructions and Reinforcement-Feedback on Human Operant Behavior Maintained by Fixed-Interval Reinforcement. *Journal of the Experimental Analysis of Behavior, 12*(5), 701-712. https://doi.org/10.1901/jeab.1969.12-701

Baum, W. M., Richerson, P. J., Efferson, C. M., & Paciotti, B. M. (2004, 2004/09/01/). Cultural evolution in laboratory microsocieties including traditions of rule giving and rule following. *Evolution and Human Behavior, 25*(5), 305-326. https://doi.org/https://doi.org/10.1016/j.evolhumbehav.2004.05.003

Baumann, A. A., Abreu-Rodrigues, J., & da Souza, A. S. (2009, 2009/10/01). Rules and Self-Rules: Effects of Variation Upon Behavioral Sensitivity to Change. *The Psychological Record, 59*(4), 641-670. https://doi.org/10.1007/BF03395685

Catania, A. C. (2013). *Learning*. Sloan Pub.

Catania, A. C., Matthews, B. A., & Shimoff, E. (1982). Instructed versus shaped human verbal behavior: Interactions with nonverbal responding. *Journal of the Experimental Analysis of Behavior, 38*(3), 233-248. https://doi.org/10.1901/jeab.1982.38-233

de Carvalho, L. C., Couto, K. C., Gois, N. d. S., Sandaker, I., & Todorov, J. C. (2017, 2017/01/02). Evaluating effects of cultural consequences on the variability of interlocking behavioral contingencies and their aggregate products. *European Journal of Behavior Analysis, 18*(1), 84-98. https://doi.org/10.1080/15021149.2016.1231003

Fox, A. E., & Kyonka, E. G. E. (2017). Searching for the variables that control human rule-governed "insensitivity". *Journal of the Experimental Analysis of Behavior, 108*(2), 236-254. https://doi.org/10.1002/jeab.270

Fox, A. E., & Pietras, C. J. (2013, May). The effects of response-cost punishment on instructional control during a choice task. *J Exp Anal Behav, 99*(3), 346-361. https://doi.org/10.1002/jeab.20

Glenn, S. S. (1986, 1986/05/01). Metacontingencies in Walden Two. *Behavior Analysis and Social Action, 5*(1), 2-8. https://doi.org/10.1007/BF03406059

Glenn, S. S. (1988, 1988/10/01). Contingencies and Metacontingencies: Toward a Synthesis of Behavior Analysis and Cultural Materialism. *The Behavior Analyst, 11*(2), 161-179. https://doi.org/10.1007/BF03392470

Glenn, S. S. (2003). Operant Contingencies and the Origin of Cultures. In K. A. Lattal & P. N. Chase (Eds.), *Behavior Theory and Philosophy* (pp. 223-242). Springer US. https://doi.org/10.1007/978-1-4757-4590-0_12

Glenn, S. S. (2004, 2004/10/01). Individual behavior, culture, and social change. *The Behavior Analyst, 27*(2), 133-151. https://doi.org/10.1007/BF03393175

Guimarães, T. M. M., Leite, F. L., de Carvalho Neto, M. B., Tourinho, E. Z., & Tonneau, F. (2019, 2019/11/01). The Effects of Punishment in Laboratory Microcultures.

Behavior and Social Issues, 28(1), 160-173. https://doi.org/10.1007/s42822-019-00004-z

Guimarães, T. M. M., Picanço, C. R. F., & Tourinho, E. Z. (2019, 2019/12/01). Effects of Negative Punishment on Culturants in a Situation of Concurrence between Operant Contingencies and Metacontingencies. *Perspectives on Behavior Science, 42*(4), 733-750. https://doi.org/10.1007/s40614-019-00224-z

Hackenberg, T. D., & Joker, V. R. (1994). Instructional versus schedule control of humans' choices in situations of diminishing returns. *Journal of the Experimental Analysis of Behavior, 62*(3), 367-383. https://doi.org/10.1901/jeab.1994.62-367

Harte, C., Barnes-Holmes, Y., Barnes-Holmes, D., & McEnteggart, C. (2017, 2017/11/01). Persistent Rule-Following in the Face of Reversed Reinforcement Contingencies: The Differential Impact of Direct Versus Derived Rules. *Behavior Modification, 41*(6), 743-763. https://doi.org/10.1177/0145445517715871

Hayes, S. C., Brownstein, A. J., Haas, J. R., & Greenway, D. E. (1986). Instructions, multiple schedules, and extinction: Distinguishing rule-governed from schedule-controlled behavior. *Journal of the Experimental Analysis of Behavior, 46*(2), 137-147. https://doi.org/10.1901/jeab.1986.46-137

Hayes, S. C., Brownstein, A. J., Zettle, R. D., Rosenfarb, I., & Korn, Z. (1986). Rule-governed behavior and sensitivity to changing consequences of responding. *Journal of the Experimental Analysis of Behavior, 45*(3), 237-256. https://doi.org/10.1901/jeab.1986.45-237

Hayes, S. C., Zettle, R. D., & Rosenfarb, I. (1989). Rule-Following. In S. C. Hayes (Ed.), *Rule-Governed Behavior : Cognition, Contingencies, and Instructional Control* (pp.

191-220). Springer. http://ebookcentral.proquest.com/lib/hioa/detail.action?docID=3084484

Insko, C. A., Gilmore, R., Drenan, S., Lipsitz, A., Moehle, D., & Thibaut, J. (1983). Trade versus expropriation in open groups: A comparison of two types of social power. *Journal of Personality and Social Psychology, 44*(5), 977-999. https://doi.org/10.1037/0022-3514.44.5.977

Insko, C. A., Gilmore, R., Moehle, D., Lipsitz, A., Drenan, S., & Thibaut, J. W. (1982, 1982/11/01/). Seniority in the generational transition of laboratory groups: The effects of social familiarity and task experience. *Journal of Experimental Social Psychology, 18*(6), 557-580. https://doi.org/https://doi.org/10.1016/0022-1031(82)90073-7

Jacobs, R. C., & Campbell, D. T. (1961). The perpetuation of an arbitrary tradition through several generations of a laboratory microculture. *The Journal of Abnormal and Social Psychology, 62*(3), 649-658. https://doi.org/10.1037/h0044182

Joyce, J. H., & Chase, P. N. (1990). Effects of response variability on the sensitivity of rule-governed behavior. *Journal of the Experimental Analysis of Behavior, 54*(3), 251-262. https://doi.org/10.1901/jeab.1990.54-251

Kaufman, A., Baron, A., & Kopp, R. E. (1966). Some effects of instructions on human operant behavior. *Psychonomic Monograph Supplements, 1*(11), 243-250.

Kissi, A., Hughes, S., De Schryver, M., De Houwer, J., & Crombez, G. (2018, 2018/12/01). Examining the Moderating Impact of Plys and Tracks on the Insensitivity Effect: a Preliminary Investigation. *The Psychological Record, 68*(4), 431-440. https://doi.org/10.1007/s40732-018-0286-z

Kudadjie-Gyamfi, E., & Rachlin, H. (2002). Rule-governed versus contingency-governed behavior in a self-control task: Effects of changes in contingencies. *Behavioural Processes, 57*(1), 29-35. https://doi.org/10.1016/S0376-6357(01)00205-4

Matthews, B. A., Catania, A. C., & Shimoff, E. (1985). Effects of uninstructed verbal behavior on nonverbal responding: Contingency descriptions versus performance descriptions. *Journal of the Experimental Analysis of Behavior, 43*(2), 155-164. https://doi.org/10.1901/jeab.1985.43-155

Matthews, B. A., Shimoff, E., Catania, A. C., & Sagvolden, T. (1977). Uninstructed Human Responding: Sensitivity to Ratio and Interval Contingencies. *Journal of the Experimental Analysis of Behavior, 27*(3), 453-467. https://doi.org/10.1901/jeab.1977.27-453

Newman, B., Hemmes, N. S., Buffington, D. M., & Andreopoulos, S. (1994). The effects of schedules of reinforcement on instruction-following in human subjects with verbal and nonverbal stimuli. *Analysis of Verbal Behavior, 12*, 31-41. https://doi.org/10.1007/BF03392895

Nielsen, M. E., & Miller, C. E. (1997). The Transmission of Norms Regarding Group Decision Rules. *Personality and Social Psychology Bulletin, 23*(5), 516-525. https://doi.org/10.1177/0146167297235007

Shimoff, E., Catania, A. C., & Matthews, B. A. (1981). Uninstructed human responding: Sensitivity of low-rate performance to schedule contingencies. *Journal of the Experimental Analysis of Behavior, 36*(2), 207-220. https://doi.org/10.1901/jeab.1981.36-207

Shimoff, E., Matthews, B. A., & Catania, A. C. (1986). Human operant performance: Sensitivity and pseudosensitivity to contingencies. *Journal of the Experimental Analysis of Behavior, 46*(2), 149-157. https://doi.org/10.1901/jeab.1986.46-149

Skinner, B. F. (1948). *Walden Two*. Macmillan.

Skinner, B. F. (1953). *Science and human behavior*. Macmillan.

Skinner, B. F. (1957). *Verbal behavior* [doi:10.1037/11256-000]. Appleton-Century-Crofts. https://doi.org/10.1037/11256-000

Skinner, B. F. (1974). *About behaviorism*. Alfred A. Knopf.

Skinner, B. F. (1976). *About behaviorism*. Vintage Books.

Skinner, B. F. (1981). Selection by consequences. *Science, 213*(4507), 501-504. https://doi.org/10.1126/science.7244649

Skinner, B. F. (1984). An operant analysis of problem solving. *Behavioral and Brain Sciences, 7*(4), 583-591. https://doi.org/10.1017/S0140525X00027412

Soares, P. F. d. R., Martins, J. C. T., Guimarães, T. M. M., Leite, F. L., & Tourinho, E. Z. (2019, 2019/11/01). Effects of Continuous and Intermittent Cultural Consequences on Culturants in Metacontingency Concurrent With Operant Contingency. *Behavior and Social Issues, 28*(1), 189-202. https://doi.org/10.1007/s42822-019-00009-8

Soares, P. F. d. R., Rocha, A. P. M. C., Guimarães, T. M. M., Leite, F. L., Andery, M. A. P. A., & Tourinho, E. Z. (2018, 2018/05/01). Effects of Verbal and Non-Verbal Cultural Consequences on Culturants. *Behavior and Social Issues, 27*(1), 31-46. https://doi.org/10.5210/bsi.v27i0.8252

Souza, A. S., Pontes, T. N. R., & Abreu-Rodrigues, J. (2012, 2012/12/01). Varied but not necessarily random: Human performance under variability contingencies is affected by instructions. *Learning & Behavior*, *40*(4), 367-379. https://doi.org/10.3758/s13420-011-0058-y

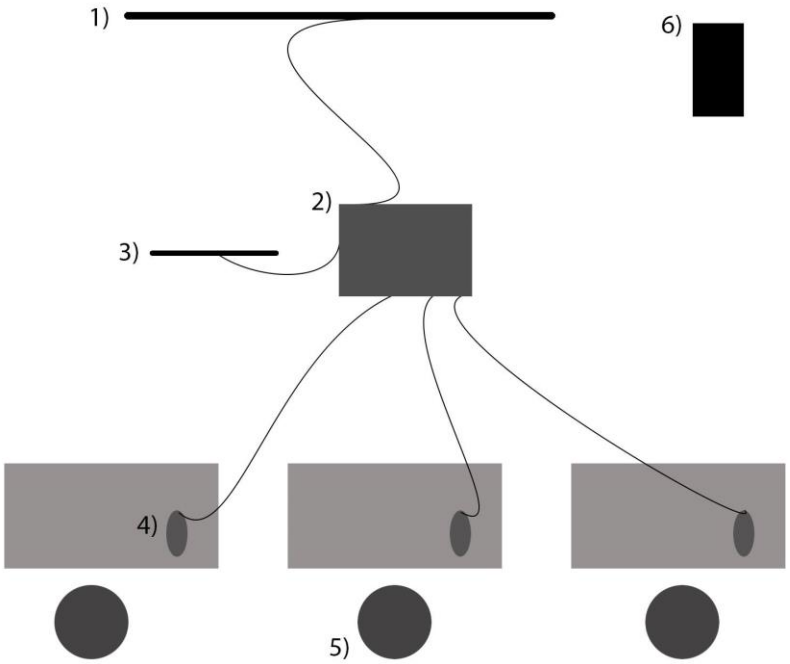
Vaughan, M. (1989). RuIe-Governed Behavior in Behavior Analysis. In S. C. Hayes (Ed.), *Rule-governed behavior : Cognition, contingencies, and instructional control* (pp. 97-118). Springer.

Vichi, C., Andery, M. A. P. A., & Glenn, S. S. (2009, 2009/05/01). A Metacontingency Experiment: The Effects of Contingent Consequences on Patterns of Interlocking Contingencies of Reinforcement. *Behavior and Social Issues*, *18*(1), 41-57. https://doi.org/10.5210/bsi.v18i1.2292

Weiner, H. (1970). Instructional control of human operant responding during extinction following fixed-ratio conditioning. *Journal of the Experimental Analysis of Behavior, 13*(3), 391-394. https://doi.org/10.1901/jeab.1970.13-391

Figure 1

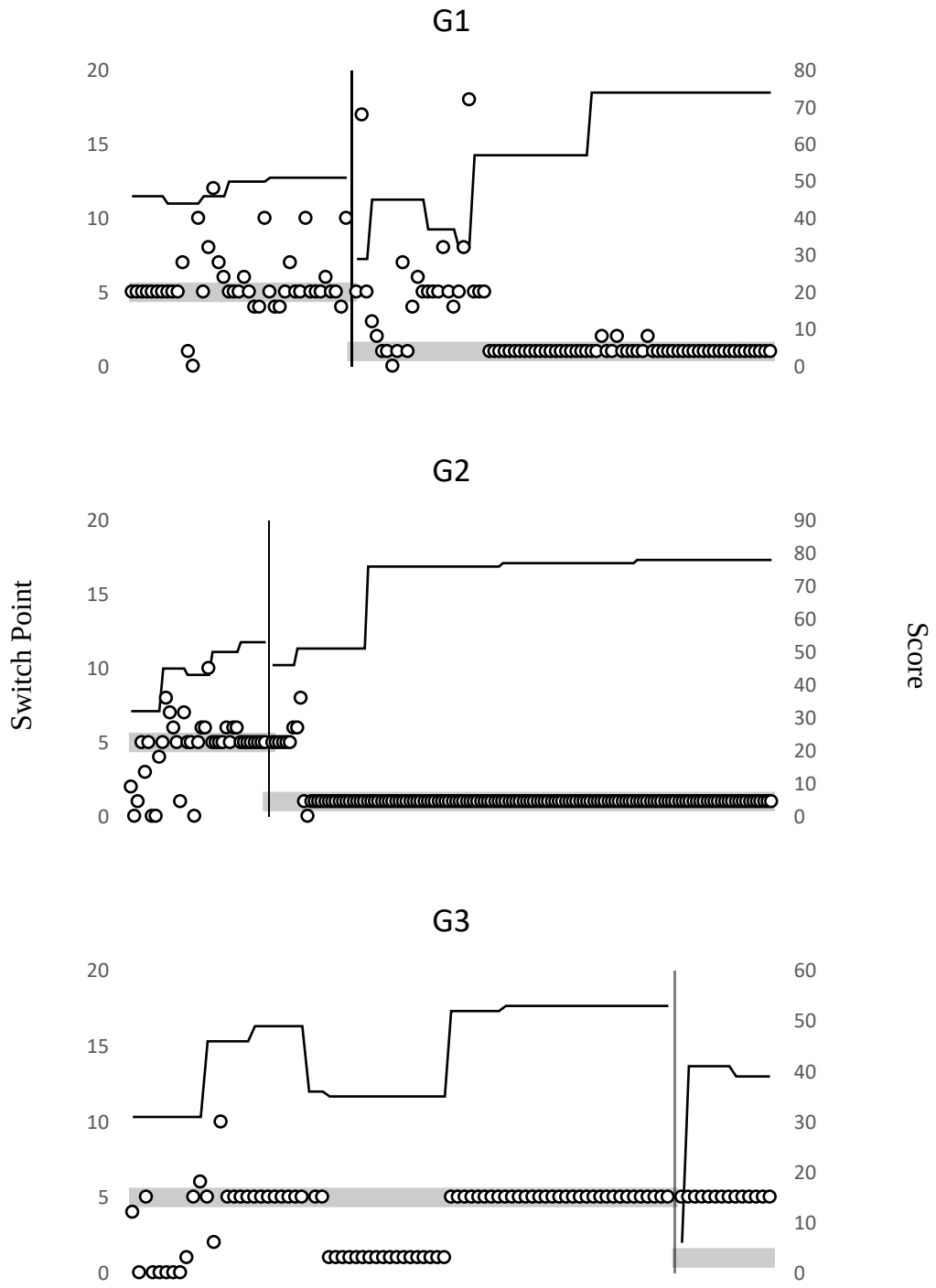
Graphic presentation of experimental room



Note. The experimental setting included: 1) Main screen, 2) laptop, 3) secondary screen not available to the participants, 4) computer mice, 5) participants and 6) video camera.

Figure 2

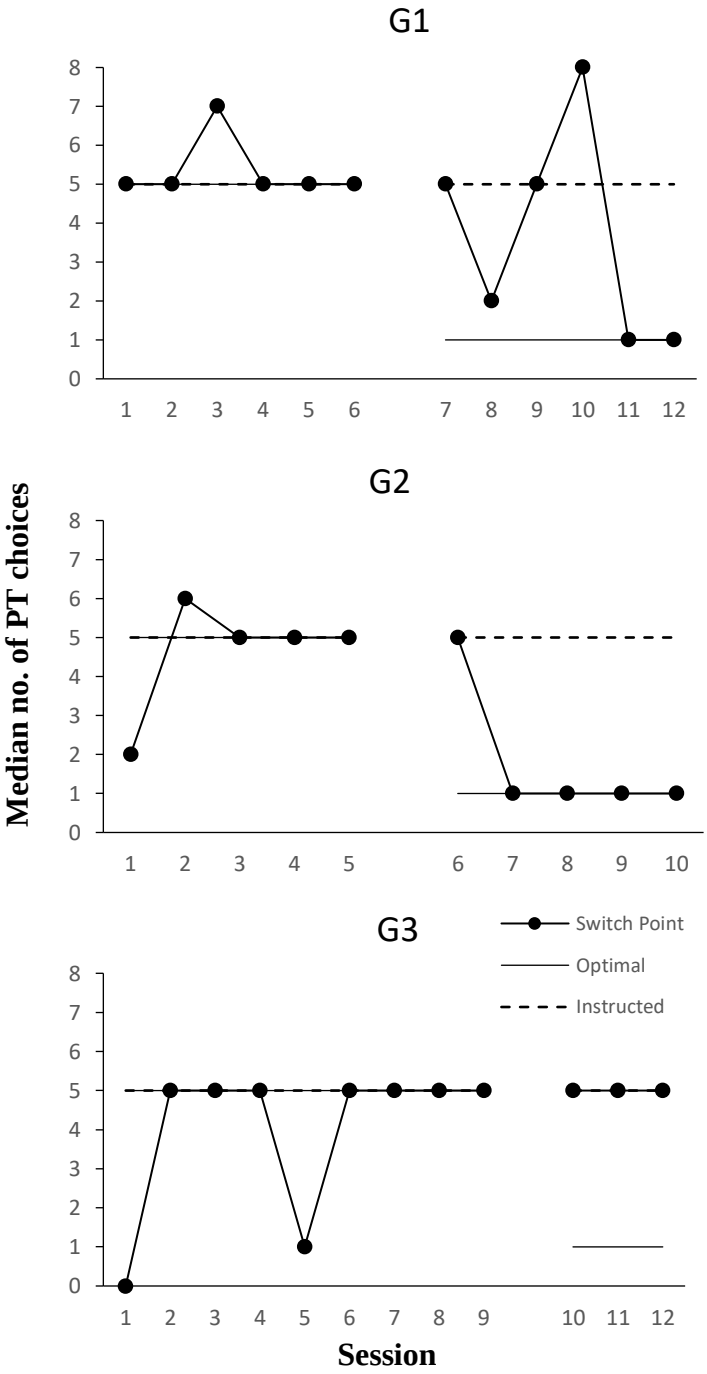
Distribution of Switch Points and Scores in Experiment 1



Note. Dot plot distribution of all switch points in G1, G2 and G3. Each circle presents one switch point. Grey bars show the optimal switch points. Solid line shows the distribution of earned points on secondary y-axis. Vertical solid line divides Phase1 and Phase 2.

Figure 3

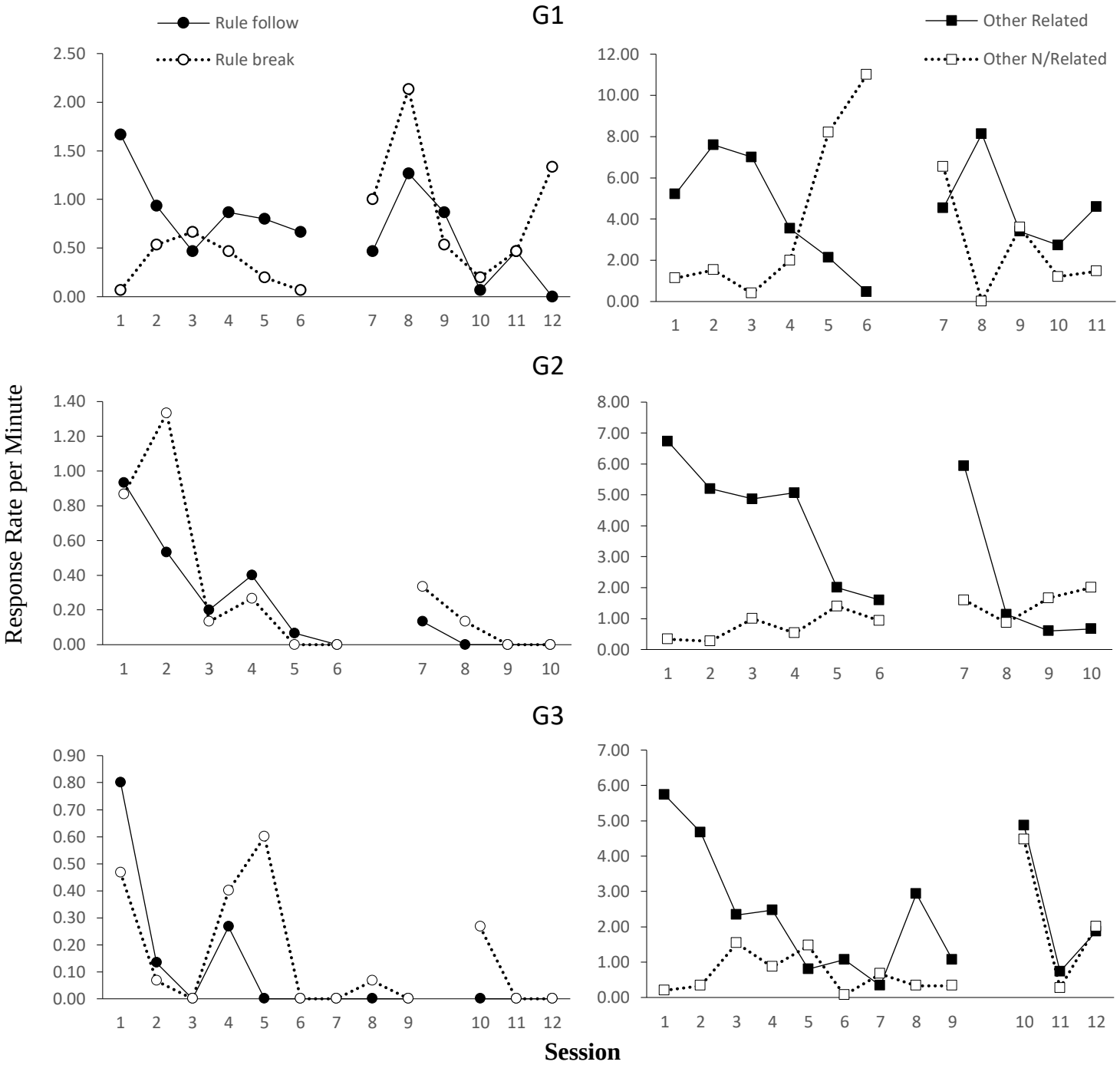
Median number of PT choices by group in Experiment 1



Note. Full line with filled circles shows the median PT choices made by session, full line presents the optimal way of earning points and dashed line presents the instructed way.

Figure 4

Participants' Theme of Interaction per minute in G1, G2 and G3

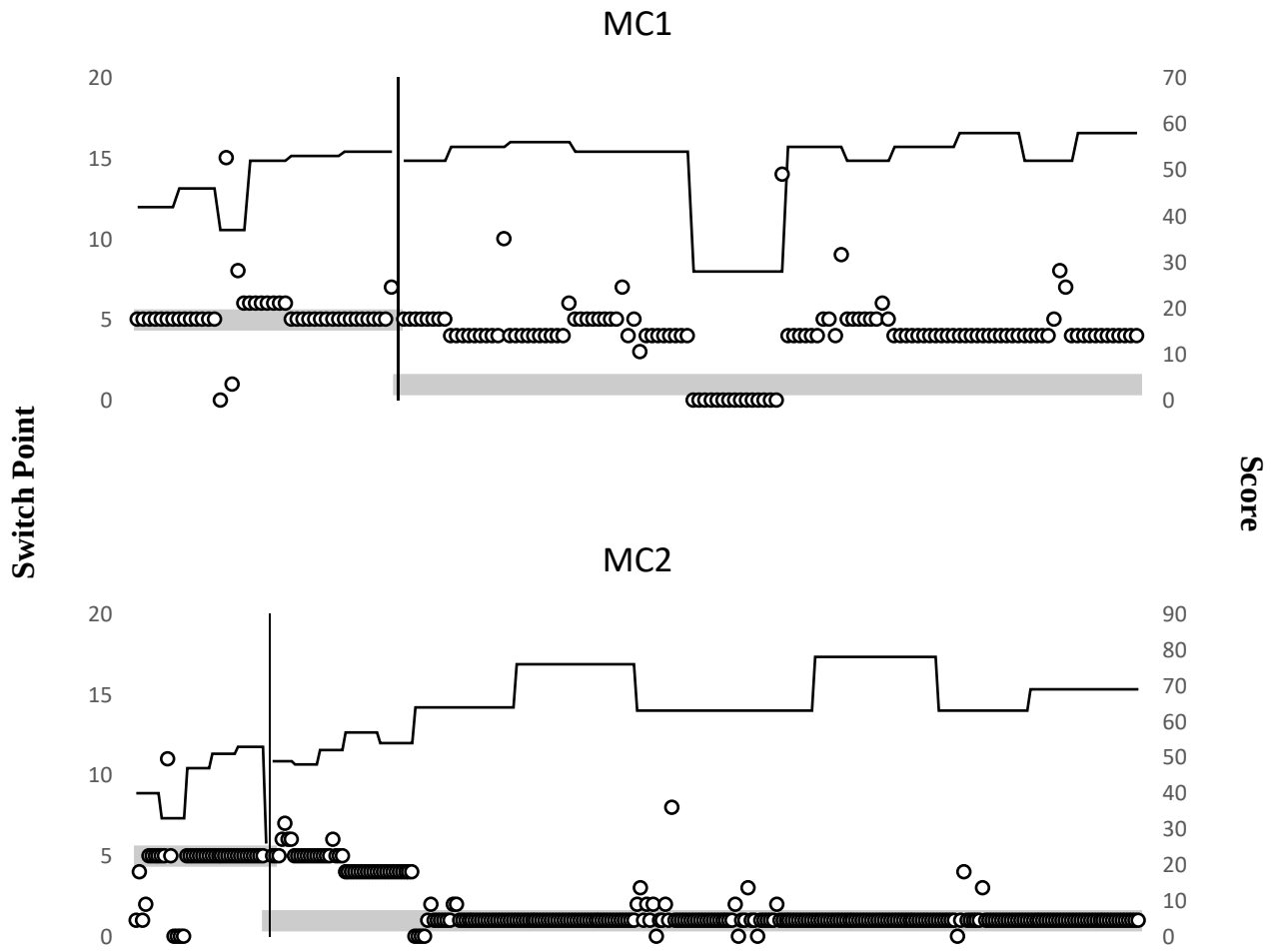


Note. The figure presents analyzed interaction between the participants in the three groups in Experiment 1. Graphs on the left side show response rate per minute of rule following (full line with filled circles) or rule breaking (dotted line with empty circles). Graphs on the right-side show response rate per minute about other communication related to the task (full line

with filled squares) or not related to the task (dotted line with empty squares). Note different values on y-axis.

Figure 5

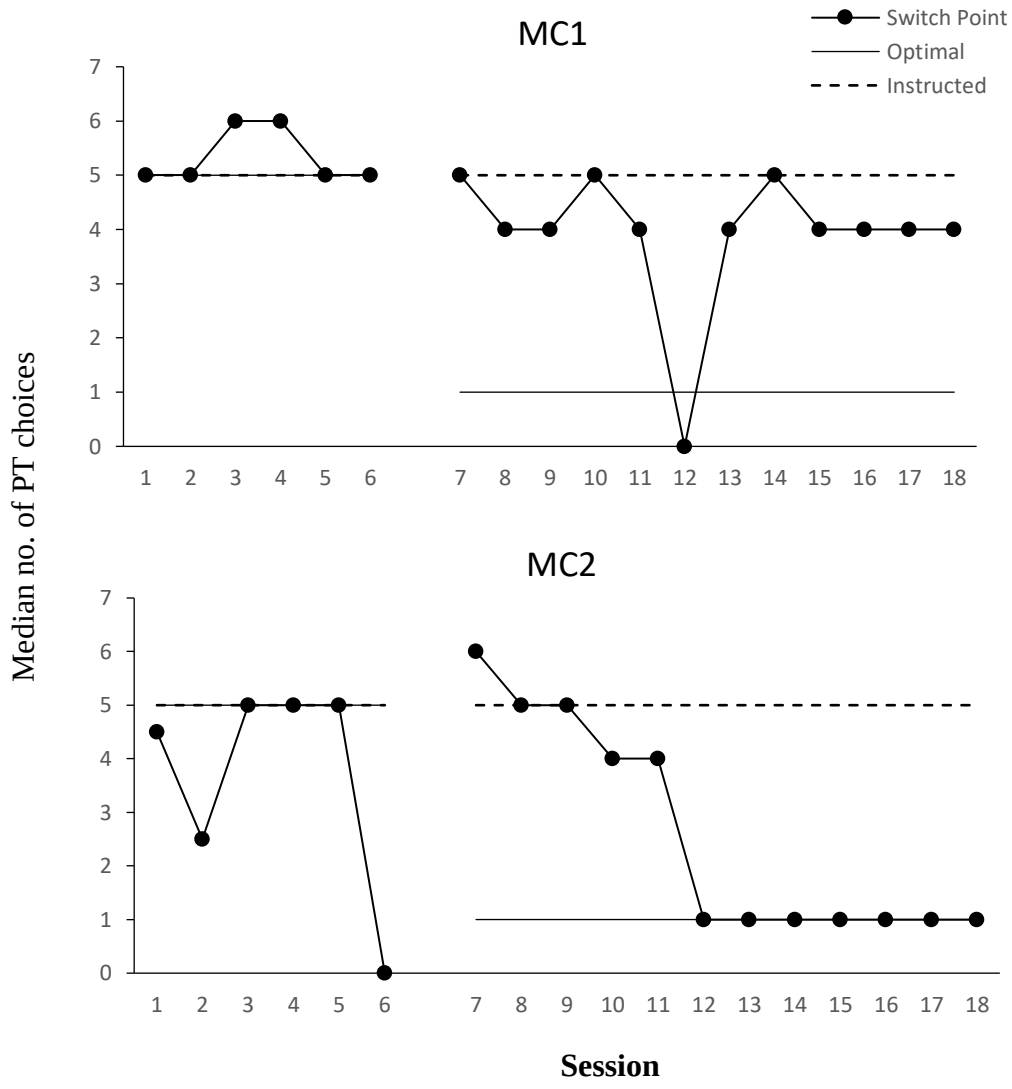
Distribution of Switch Points and Scores in Experiment 2



Note. Dot plot distribution of all switch points in MC1 and MC2. Each circle presents one switch point. Grey bars show the optimal switch points. Solid line shows the distribution of points on secondary y-axis. Vertical solid line divides Phase1 and Phase 2.

Figure 6

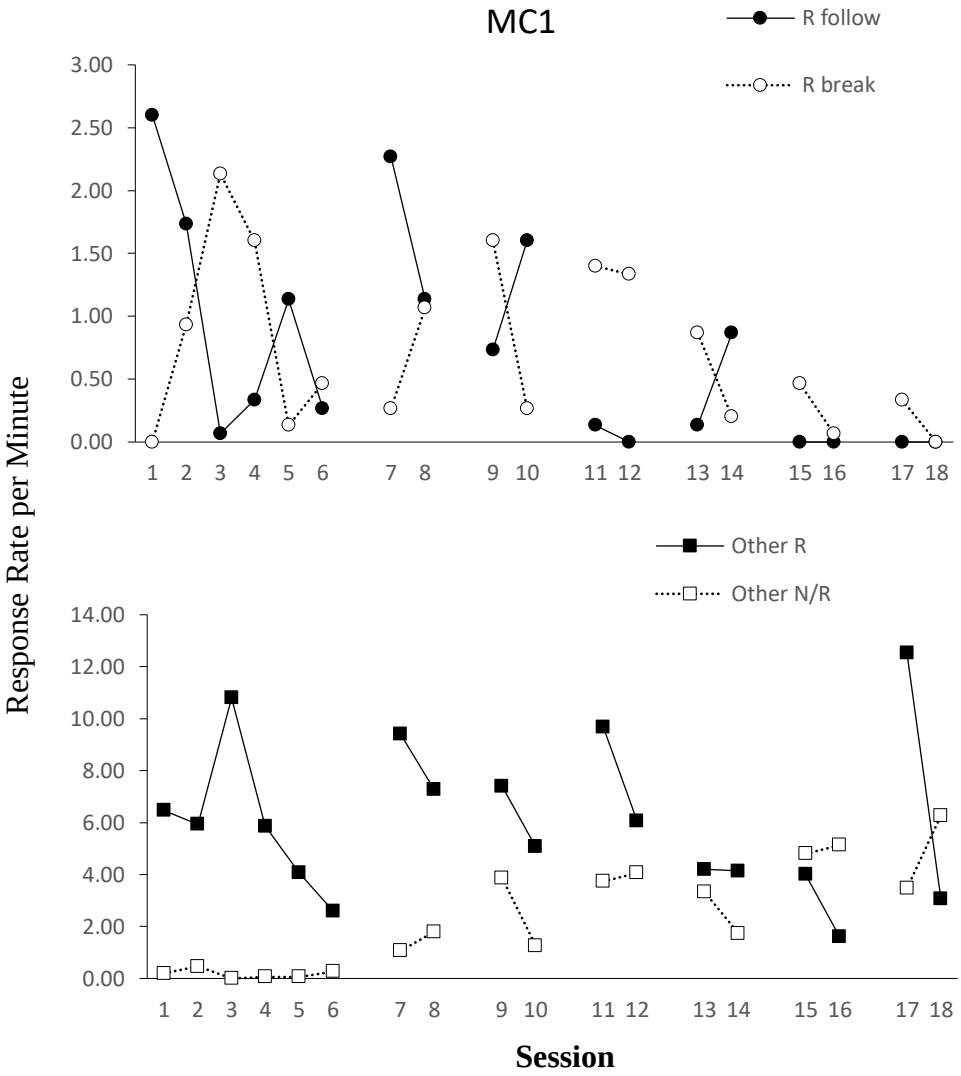
Median number of PT choices by group in Experiment 2



Note. Full line with filled circles shows the median PT choices made by session, full line presents the optimal way of earning points and dashed line presents the instructed way.

Figure 7

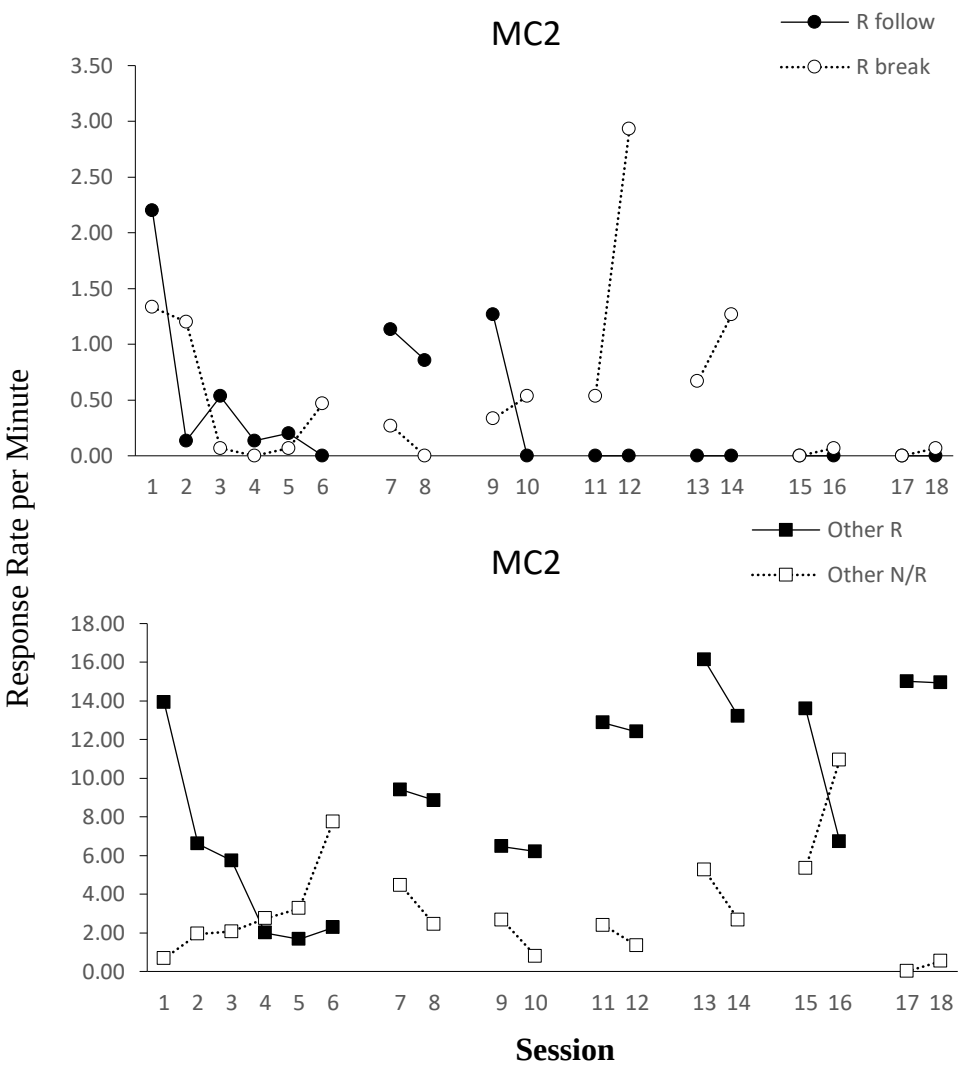
Participants' Theme of Interaction per minute in MC1



Note. The figure presents analysed interaction between the participants in MC1 in Experiment 2. The graph above shows response rate per minute of rule following (full line with filled circles) or rule breaking (dotted line with empty circles). The graph under shows response rate per minute about other-related to the task (full line with filled squares) or not related to the task (dotted line with empty squares). Note different values on y-axis.

Figure 8

Participants' Theme of Interaction per minute in MC2



Note. The figure presents analyzed interaction between the participants in MC2 in Experiment 2. The graph above shows response rate per minute of rule following (full line with filled circles) or rule breaking (dotted line with empty circles). The graph under shows response rate per minute about other-related to the task (full line with filled squares) or not related to the task (dotted line with empty squares). Note different values on y-axis.

Appendix

Reflection note on ethics and privacy protection

The empirical study was approved by The Norwegian Center for Research Data (NSD), reference no. 896173, in 2019. Video and audio data were collected during the experiments, which were safely stored under the requirements of NSD. These data were transformed into transcripts, where the participants were referred to anonymously - with numbers, thereby their privacy was protected. The safely stored video and audio data will be deleted after completion of the project.