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Name: Mateusz Mysior

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STORBYUNIVERSITETET

Summary

This master thesis is a study on the transfer of function in equivalence classes and its effect on preferences. The thesis is composed of two articles where the first part is a literature review of studies done in the field of behavioral analysis where the emergence of equivalence classes with positively or negatively valenced stimuli alternated preferences. The review looks at how the transfer of function in those classes affects the choice situation. The second part is an empirical study which design is similar to the studies included in the review from part one. The aim was to see if the results would be replicated and introduce a new variance by expanding the choice situation. Both articles conclude that although there is strong evidence that the equivalence class influences the preferences, there is a need for further investigation of the variables affecting the preferences.

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A Literature Review of Transfer of Function in Research of Stimulus Equivalence and its Influence on Preferences

Abstract

This literature review assessed ten articles to present and summarize the current state of knowledge on the influence stimulus equivalence can have on choice. The articles included in this review are written in English or Norwegian, published in peer-reviewed journals and conducted with human participants. The review looks at the age of the participants, tailoring of stimuli as well as training structure. The effects of the emergence of stimulus equivalence on preference and choice situations in the experiments are presented and discussed. All the studies included in this review used matching-to-sample to test for responding in accordance with stimulus equivalence. The results point that the emergence of equivalence classes containing positively or negatively valenced stimuli can alternate the preferences.

Keywords: choice, emergent relations, derived relations, matching-to-sample, preferences, stimulus equivalence, transfer of function

A Literature Review of Transfer of Function in Research of Stimulus Equivalence and its Influence on Preferences

Stimulus equivalence is a phenomenon where the emergence of accurate responding to untrained and not reinforced relations occurs. Stimulus equivalence was extensively studied by Murray Sidman, a person to be considered to lay the foundation for modern understanding of the phenomena.

In the article *Equivalence Relations and Behavior: An Introductory Tutorial* Sidman (2009) explains how conditional discrimination training can lead to the emergence of untrain relations between the stimuli. He employed a matching-to-sample to teach the participants that when they are presented with the stimulus A1, they must match it to stimulus B1. The basic procedure for Sidman's experiments was matching-to-sample (Sidman, 2009), where participants had to match comparison stimulus to the sample stimulus. If a participant is presented with a sample stimulus A1 and then comparison stimuli B1, B2, B3, B4, the response is only reinforced if participant chooses correct stimulus B1. If the sample stimulus is A2 they must choose B2 and so on. Next step was to teach relation of A1 to C1 by reinforcing the selection of C1 (and not C2, C3, C4) when presented with A1 sample stimulus. Once those baseline relations were trained and correct responding occurred next step was to introduce test trials with B1 stimulus as a sample stimulus and C1, C2, C3, C4 as comparison stimuli. Those test trials were presented under extinction condition, which means that the selection of the comparison stimuli did not have any programmed consequences. The B/C relation was not trained before, and the participant had to select the comparison stimuli without history of reinforcement for this response. The selection of C1 in this example would be correct and since it was not directly trained it is said to emerge.

However, the emergent relation between B and C stimuli does not provide sufficient evidence of stimulus equivalence. As argued in Sidman & Tailby (1982) this is a "if…then" relation which is a form of interaction in the ongoing procedure. The difference between learned conditional discrimination and stimulus equivalence is that in the latter, the stimuli become interchangeable and the properties of relation between those stimuli: reflexivity, symmetry and transitivity must be tested. The first one is a relation between the stimulus and itself, (e.g., A=A). The second property of stimulus equivalence describes symmetry in relation to two stimuli (e.g., A=B then B=A). Symmetry requires both stimuli to be functionally interchangeable. In the test for equivalence stimulus a participant would be presented stimulus A and must match it with stimulus B as well as B to A without reinforcement. The last property builds on the previous, where relations A=B and B=C have been acquired and results without any instructions or reinforcement in A=C and C=A (Sidman & Tailby 1982). If this relation was not directly trained and shows properties of reflexivity, symmetry, and transitivity with the rest of the class members, then it can be an example of emergent relation. It is important to note that the relation between the stimuli is arbitrary and the stimuli do not have to resemble each other, nor have anything in common to belong same class except for the set relation in the matching-to-sample training.

There are three main training structures used to establish conditional discriminations. The first is linear series (LS) where the training starts with AB relation followed by BC relation, hence called linear A →B →C. The second, many-to-one (MTO) where relation AC and BC, many sample stimuli are trained to one comparison stimulus. The third training structure is one-to-many (OTM) AC, AB where the sample is used as a node (Arntzen 2012). There are also two

ways of arranging the matching-to-sample procedure. Simultaneous matching-to-sample (SMTS) and delayed matching-to-sample (DMTS). In the SMTS the sample stimulus is presented together with the comparison stimuli and stays present until the comparison stimulus is selected. While in DMTS the participant is shown a sample stimulus and after a variable time, a pair of comparison stimuli (Arntzen 2012).

From a small number of trained relations there can emerge a much larger number of relations without reinforcement. A mathematical representation from Fields et al. (2020) shows that in a single class with four members (N=number of members in a class), there is sixteen relations between those stimuli (N^2). An equivalence class can be formed by training N-1 relations which are called baseline relations. In our example it will be three relations, however there is thirteen (N^2-N+1) untrained relations from training only three. Those numbers are becoming even more impressive with bigger number of class members.

The emergence of relations brings us to another phenomenon occurring in equivalence classes – the transfer of function. For members of an emerged equivalence class, a new function trained for one member of the class will also be demonstrated by other members of the class (Dymond & Rehfeldt, 2000; Sidman 1994). Dougher et al. (1994) conducted an experiment where eight participants underwent conditional discrimination to train 6 relations in matching-to-sample program. Then they were tested for emergence of four-member equivalence class. After that in the first class (A1, B1, C1, D1) the B1 stimulus was paired with an electric shock. In the other class (A2, B2, C2, D2) the presentation of B2 stimulus was not paired with a shock. The skin conductance was used as a measure of conditioning. They found that in the first equivalence class, other members C1 and D1 also elicited the sink conductance (sweat) similar to B1 while

there was an absence of such response in the equivalence class without the electric shock. In the second experiment they replicated the first experiment and later one of the members from the "electric shock equivalence class" was presented without the shock. The transfer of extinction was transferred to the other members of the same equivalence class – the stimuli did not elicit the sweat response longer. In the final part of the experiment the extinction was replaced with conditioning and all the members of equivalence class produced skin conductance again.

Dougher & Markham defined transfer of function as "untrained acquisition or emergence of stimulus functions among members of stimulus classes" (1996, p.139). Whether the emergence of stimulus equivalence is the result or the cause of transfer of function is still to be examined (Dougher et al., 1994). Sidman (1994) was critical to the use of the term transfer of function as a behavioral process. He argued that this descriptive term was defined after observing often ending in circular reasoning where the transfer of function was observed and named so that it can be used as an explanation. Sidman then came with another term which was not descriptive but a theoretical term – intersection:

> Different classes that possess members in common may merge into a single class—set union—or may remain independent—set intersection. Contextual components of the contingency determine whether set union or intersection takes place. None of this requires more than a description of the events that make up an observable reinforcement contingency (Sidman, 1997, p. 265).

A new approach to the transfer of function came together with Relation Frame Theory (RFT) which is a behavioral theory of human language and cognition. It shares common grounds

with Skinner's work but differs when it comes to view on language since in the RFT the language is an activity and not a product (Gross & Fox, 2009). In the RFT the transfer was substituted with the term *transformation* and became defining feature of derived relational responding (Dymond & Rehfeldt 2000). In the RFT model the *relational frame* describes a generic pattern of arbitrarily bidirectional responding that shows the *mutual entailment* (can be described as *symmetry*), *combinatorial entailment (*corresponds with *transitivity) (*Gross & Fox, 2009). There are many similarities between the stimulus-equivalence and the RFT but in case of the RFT it is more of a generic frame not based on a mathematical model. RFT model studies behavior under control of stimuli according to more relations than equivalence such as hierarchical, temporal, spatial in relations, such as: bigger- than, before-after, earlier -later and so on. This paper will not go deeper in the RFT theory as it differs with stimulus equivalence on one very important part which is that "The transformation of stimulus functions seen in the literature on derived stimulus relations indicates that stimuli can acquire behavioral functions based solely on their participation in verbal relations with other events" (Gross & Fox, 2009, p.87).

However, one thing which we shall underline is that throughout this paper the use of the term *transfer of function* is used not as an explanation but as a description of observed phenomena.

Stimulus equivalence and the transfer of function have been studied in many aspects like self-awareness, stereotyping, dreaming, sexual arousal, racial bias, rule following and verbal behavior, as mentioned by Dymond & Rehfeldt (2000). There is a growing body of studies done on preferences with evidence of stimulus equivalence affecting preferences as we will see in this

review. Our preferences are affecting every aspect of our life, from what we eat for breakfast, with what people we spend time with, as well as what products we buy. As the preferences affects our choices that also implies that a small change in preference for some eco-friendly products can have big impact when applied to a larger population. The preference for food can have health implications when the choice is between unhealthy, low in nutrition food like fast food and well balanced, nutritional meal. There is a need for a review of existing studies to see in what way the preference was intended to be altered and if the results are consistent from the studies. In the behavior analytic framework, the dominant approach to preferences has been through classical conditioning (Arntzen, Fagerstrøm, et al., 2016). Can stimulus equivalence be a potential factor in forming preferences? This literature review will look closer on transfer of function in the experiments regarding choice situations. The review starts with the description of method which was used to find the relevant articles on the topic. Then, the results of the search are presented with a short summary of the effects of the transfer of function on preference in each of the articles.

Method

The searches began after consulting the university librarian on February 17th and lasted for several days until March 14th, 2021. The databases which were used to gather the articles were: PsycINFO, ERIC, Web of Science and in the three following journals: *Journal of the Experimental Analysis of Behavior* (JEAB), *Journal of Applied Behavior Analysis* (JABA), *The Psychological Record* (TPR) as they are central journals in the field of behavior analysis.

Inclusion and Exclusion Criteria

The articles reviewed had to investigate how the transfer of function in a stimulus equivalence class can influence preferences. The additional inclusion criteria applied when choosing the articles were that they had to be written in English or Norwegian and be published in peer-reviewed journals. Moreover, the studies had to use matching-to-sample to test for responding in accordance with stimulus equivalence and be conducted with human participants.

Furthermore, the review excludes those studies in which the equivalence classes emerged with additional alterations like classical conditioning or the studies. Moreover, the review does not include the articles on racism because it is a more complex topic, and it would be reducing to call it preference.

Keywords

To find the relevant studies, the combination of the following keywords was used: *emergent relations, derived relations, transfer of function, stimulus equivalence, equivalence class, transfer of function, choice, preference.* An example of one search string was:

stimulus equivalence OR equivalence class OR emergent relations OR derived relations AND transfer of function OR preference. Different combinations of the keywords were used to try to find all relevant articles.

Screening Process

Figure 1 presents the process of searching and number of articles from each database search, that were imported to endnote program – leading to 336 articles. In addition, five records

from other sources were added. Next, the duplicates were removed, leading to 167 articles. From this point the title and/or the abstract were read to find the relevant articles meeting the criteria. Hundred and fifty-one articles were removed because they did not meet the criteria leading to 16 articles being considered. Six articles were excluded because they did not answer a question on preference or included classical conditioning in their method. Which resulted in a total of ten studies included in this review.

Results

Participants

The experiments can be divided into two main groups: conducted with children or with adults. The experiments with children (dos Santos & de Rose, 2018, 2019; Smeets & Barnes-Holmes, 2003) were performed with children between five and six years old. All three experiments had both male and female participants, ranging from 12 to 20 participants. The experiments conducted with adults (Arntzen, Eilertsen, et al., 2016; Arntzen, Fagerstrøm, et al., 2016; Barnes-Holmes et al., 2004; Dixon et al., 2017; Eilertsen & Arntzen, 2017, 2020; Keenan et al., 2020) had participants from age 18 and more. Many of those studies were performed with participants with the mean age of twenty (Arntzen, Eilertsen, et al., 2016; Arntzen, Fagerstrøm, et al., 2016; Barnes-Holmes et al., 2000; Eilertsen & Arntzen, 2017, 2020). The amount of the participants in all of the studies varied from five to forty. All the experiments were performed on typically developing participants.

How was the preference measured?

The studies include different test for preference which was measured by presenting the participants with choice situation. In six of the studies (Arntzen, Eilertsen, et al., 2016; Arntzen, Fagerstrøm, et al., 2016; Barnes-Holmes et al., 2000; Eilertsen & Arntzen, 2017; Smeets & Barnes-Holmes, 2003) the choice situation was between beverage (cup of coke, water bottle) two of the studies (dos Santos & de Rose, 2018, 2019) had presented choice of snacks to the participants and in the other two participants had a choice of allocation of tokens/casino chips (Dixon et al., 2017; Keenan et al., 2020). The main assumption of the studies was that by emerging of different stimulus classes with one class having a ¨positively¨ valenced class member and others either ¨neutral¨ or ¨negatively¨ valenced, transfer of function between stimuli could be observed within equivalence classes. This would result that later in the posttest the participant presented with a choice of objects would choose the one which belonged to the same class where the positively valenced stimulus was. The assumption was that this would happen even if the presented object had a label or sign of a stimuli which was not directly trained to be associated with valenced stimuli.

Some of the studies included pretest where they measured the choice made before the training (Barnes-Holmes et al., 2000; Dixon et al., 2017; Eilertsen & Arntzen, 2017; Keenan et al., 2020). The point of the pretest was to eliminate possibilities that the participants had some preexisting preferences towards a certain stimulus.

Tailoring of Stimuli

Some studies have also included an assessment test where the participants were asked to rate pictures or choose most/least favorite, which were later were used as class members (dos

Santos & de Rose, 2018, 2019; Eilertsen & Arntzen, 2020). This addition was meant to increase the chance that the stimuli presented in the study were perceived by the participants in the intended way. For example, dos Santos & de Rose (2018) used cartoon characters as valenced stimuli. Children who were participants in this experiment were asked to point their most favorite character and the one they disliked in the beginning of the experiment. Therefore, one child could choose Spiderman as their favorite character and Joker as the least favorite, while another child could choose Joker as the most favorite. Later the stimuli of Joker's picture would be different. For the first child Joker would be A2 (negatively valenced), while for the second child, it would serve as A1 (positively valenced). In this way, the experimenters tried to avoid varying personal preferences affecting stimulus control.

Training structure in the experiments

Most of the experiments used One-to-Many training structure AB/AC (Arntzen, Eilertsen, et al., 2016; Arntzen, Fagerstrøm, et al., 2016; Dixon et al., 2017; Eilertsen & Arntzen, 2017, 2020; Keenan et al., 2020). The other experiments used linear series AB/BC (Barnes-Holmes et al., 2000; dos Santos & de Rose, 2018, 2019; Smeets & Barnes-Holmes, 2003).

Four of the experiments was performed with Simultaneous Matching-to-sample (SMTS) sample presentation (Arntzen, Eilertsen, et al., 2016; Eilertsen & Arntzen, 2017, 2020; Keenan et al., 2020) and five used Delayed matching-to-sample (DMTS) (Arntzen, Fagerstrøm, et al., 2016; Barnes-Holmes et al., 2000; dos Santos & de Rose, 2018; Smeets & Barnes-Holmes, 2003). The transfer of function was observed in all of the studies regardless of the training structure or arrangement in presenting the stimuli in the matching-to-sample. This was expected as there are

different studies showing the MTO to be the most effective structure while others provide proofs for the OTM (Arntzen 2012).

Effects of the transfer of function on preferences

Arntzen, Eilertsen, et al. (2016) demonstrated that it's possible to influence preference in a choice situation by training a specific function to a stimulus in an emerged equivalence class. In this experiment, the participants were divided into two groups. Both groups were trained to establish three 3-member equivalence classes of abstract stimuli. Later, both groups underwent training for class expansion. For the first group the classes were expanded with a weather symbol: a sun, cloudy weather, and a raincloud. For the second group pictures of similarly looking dikes were used. Later the participants were presented with a choice of water bottles with printouts of an abstract stimulus from each of the equivalence class as a label. The summary of the choices showed that 55% of the participants from group one selected the bottle with a stimulus from the same group as the sunny weather symbol. 25% selected the cloudy weather and only 20% chose raincloud. In comparison, the other group with neutrally valenced stimuli in form of dikes had more evenly distributed the selection between the dikes as follow 35%, 30% and 35%. That points to the conclusion that the choice between three identical bottles was affected by training the weather symbols to the nodal stimuli in an emerged equivalence class.

Similarly, (Arntzen, Fagerstrøm, et al., 2016) has been based on three 3-members equivalence classes. The expansion class stimuli which were meant to work as a preference alternator were three emoticons: a smiley face, neutral face, and a sad face. The participants, at the end of the experiment were presented with a choice of water bottles with abstract stimulus

from each of the three equivalence classes (B1, B2 and B3). The choice situation resulted in 13 out of 16 participants selecting bottles with the symbol from the same class where the smiley emoticon was.

Third article by Barnes-Holmes et al. (2000) where participants were trained to form three-member equivalence classes. The first class contained word “CANCER” a nonsense syllable “VEK” and word “BRAND X”. The other class included word “HOLIDAYS” a nonsense syllable “ZID” and a word “BRAND Y”. The participants after they have formed the equivalence classes were asked to taste two colas and rate. One with a label “BRAND X” and the other with a label “BRAND Y”. The aim of the study was to see if the meaning of the words “CANCER” and “HOLIDAYS” could transfer to the other members of the class influencing the ratings of the taste. The study was composed with three experiments and the transfer of function occurred in all of them. In the first experiment 27 participants who have passed the training with sufficient criteria. 16 of them rated the taste of the cola that had a label with the BRAND X from the same equivalence class as HOLIDAYS higher than the cola of BRAND Y which was in the same class as word CANCER. On the contrary only 4 participants liked taste of CANCER cola better than HOLIDAY cola. In the second experiment, the procedure was changed and the testing for the emergence of equivalence classes was omitted. The point of this alternation according to the authors was to eliminate possibility that during the testing for equivalence the subsequent presentation of stimuli could be a form of classical conditioning. The results for the second experiment were as follow: with 8 participants, 6 rated HOLIDAY cola as tasting better than cola labeled with syllable equivalent to CANCER. The third experiment in this study was a replication of the second, but after the participants had established equivalence classes and rated

the colas the participants continued the experiment with an addition of reversing the the BRAND X and BRAND Y. The two stimuli were changed between their equivalence classes to see if the rating of the beverage would also change. The results showed for all 6 participants a reversed ratings for taste after the label BRAND X and BRAND Y were switched.

In the fourth paper by dos Santos & de Rose (2019) the experimenters studied if children would choose food in a container with a symbol equivalent to their liked cartoon character over food in containers with symbols which belonged to equivalence classes of disliked character or abstract symbols. The food was identical in all of the containers. The results from the study were that all of the kids chose first food in containers with labels equivalent to the liked cartoon character and they reported that they also preferred taste of the food from this container to others. However, in testing for preference between boxes with symbols equivalent to a disliked cartoon character and neutral labels, the children chose the first. The authors indicate that some earlier research showed the preference for labels containing known media characters over labels without them as a possible explanation. It is also suggested that the "disliked" character can be selected since it is a part of the story. It stands in the hierarchical relation and the function of the higher-level can be transferred to the lower-level item (Griffe & Dougher, 2002; Slattery & Stewart, 2014 in (dos Santos & de Rose, 2019) Hence the disliked characters were still more attractive to the children than a neutral packing.

The fifth paper Eilertsen & Arntzen (2017) presents an experiment where in pre test the participants had to make a choice between three water bottles with three different Chinese symbols which for the participants were supposed to be abstract symbols. The participants made

a choice for one bottle. The choice results showed no significant difference between the chosen bottles. The participants proceeded with conditional discrimination training to form three 3-memeber equivalence class. Later in the training every class was expanded with a banknote of different value (50, 100 and 200). After the testing for emergence of three 4-member equivalence classes the participants were asked to make a choice between the same exact bottles. After the training over, 60% chose water bottle with symbol corresponding to the banknote of the highest value. Its worth to mentioned that in this study the participants with the lowest number of trials were those who chose banknotes of the highest value.

The sixth paper Eilertsen & Arntzen (2020) presents the study where participants were asked to rate six images of needle injection from most to least painful. Later the one most and least painful of those images were used in class expansion phase together with a picture of a cotton swab touching a hand. The posttest for preference in the experiment showed that only two participants chose water bottle B1 corresponding to the most painful, seven participants chose B2 a "not painful water'' and six chose the B3 "cotton swab'' bottle. It is worth to note that the participants who chose B2 they also have rated the degree of pain as the lowest on the scale.

The seventh study Keenan et al. (2020) tried to investigate how the transfer of function can influence allocation of tokens to members in groups when some of them are given social label. In the experiment there were established two 3-member equivalence classes of nonsense syllables. After the participants were tested for emergence of stimulus equivalence, a social label was assigned to the B1 stimulus stating that this is "a good person". After, the participants had to distribute tokens between the members of the classes. The results showed that class one which

contained the “good person” has received one average more tokens with the positively valenced stimuli having most of the tokens. Next, started a new session where experimenter stated that there was a mistake and the stimulus B1 “is actually a bad person”. The participants were asked to allocate the tokens again. One the social label was reversed from positive to negative the allocation of tokens to B1 dropped significantly, resulting in lowest number of allocated tokens. Similarly, the distribution of tokens to the members of the class has decreased. The experiment was than replicated but with a prior distribution of tokens, before any social label was added to the B1 stimuli. It was serving as a baseline for the distribution. In the replication the increase allocation of tokens to the members of class with positive social label could be observed. With the B1 stimulus receiving majority of the tokens and equivalent stimulus in the class reviving more than in the members in the second class. In the replication experiment once the social label was reversed from “good” to “bad person” the allocation of the tokens to the B1 dropped. However, the rest of the members of the same equivalence class did not experience a lower distribution of the tokens.

The eighth paper dos Santos & de Rose (2018), looked at how cartoon characters could influence food choices. The paper consists of three preference tests which were conducted between two to four days after conditional discrimination training and testing for equivalence. In the first test, the children had to choose between food with labels presenting symbols equivalent to the liked and disliked character. In the test, 90% of children picked the containers equivalent to the liked character. When the children were asked to try food from other container and say which one, they prefer (food was identical in all of the containers) 80% of children chose the “favorite character” container. In the second test, they had to choose between a symbol

equivalent to the disliked character and a new symbol, 90% of children chose the novel symbol and 80% reported that it tasted better than the food from the container with symbol representing the disliked character. In the third test the decision was between symbol equivalent to the liked character and a known brand, the results were 70% of children chose to taste food labeled with the known brand first. Interestingly only 50% of them preferred more than the food labeled with "favorite character".

The ninth paper by Smeets & Barnes-Holmes (2003), was composed of two experiments. In first part the children were trained on matching-to-sample tasks with one class containing a smiling cartoon character and the other class a crying child, the rest of the class members were geometric shapes. After testing for equivalence, the children were presented with a choice between two soft drinks (the samples were the exact same drink). The first was labeled with stimulus C1 (equivalent to the smiling cartoon character) and the other drink was labeled with C2 stimulus (in the same class as the picture of a crying baby). After the children tasted the drinks, they were asked to indicate which one they preferred. The second experiment was conducted the same as the first but without the testing for equivalence. The results from experiments showed that children chose first drink with A1 stimulus (88% in the first and 94% in the second experiment. In both experiments, 90% of children preferred the taste of it.

In the last paper, Dixon et al. (2017) twenty-five recreational gamblers were instructed to place their bets on either red or black position. Later they underwent training where two equivalence classes have emerged. One class was with a color and traditionally positive words such as *love, happy, sex, kiss* the other had a color and negative words such as *debt, taxes, cancer, worry.* After that they were again asked to place their bets on one of the colors. Twenty-

one out of twenty-five have allocated their bets onto positions with color equivalent to the positive words. The summary of the results is presented in Table 1.

Studies Excluded

The studies excluded from the review have some interesting aspects. Therefore, they will be briefly reported:

Derived relations and generalized alteration of preferences (Valdivia-Salas et al., 2013) and *A Derived Transfer of Mood Functions through Equivalence Relations* (Barnes-Holmes et al., 2004) both studies in their experiments have included a form of classical conditioning. In the first study Valdivia-Salas et al., (2013) the participants underwent operant training where four geometrical shapes were established as discriminative stimuli contingency of presenting of four pictograms: B1, B2, C1, C2). Then participants underwent matching-to-sample procedure where the B1 stimulus was paired with aversive slides and a noise while the B2 stimulus was paired with pleasant slides. After the participants were tested for emergence of two 3-member classes the 82% of them have selected B2 and C2 in the most trials. Since the topic of this literature review are studies where the stimulus equivalence emerges without adding any conditioning procedure the study was excluded. Similarly, the study by Barnes-Holmes et al. (2004) where in the musical mood induction procedure was used to induce happy or sad mood. In addition, the study did not include any preference test and therefore was excluded.

Nodal structure and stimulus relatedness in equivalence classes: Post-class formation preference tests (Moss-Lourenco & Fields, 2011) The focus of the study was on the effects of nodal distance on the relatedness of stimuli. The preference referred to the choice of comparison

stimuli which was tested after class formation. It is hard to consider it as an experiment done on the alternation on the preference by the stimulus equivalence as the choice measured preference for the nodal proximity in the established class. It does not meet the criteria and therefore the article was excluded.

Finally, the article *Changing racial bias by transfer of functions in equivalence classes* (Mizael et al., 2016) looked into the racial biases and how they could be affected by stimulus equivalence. The matching-to-sample was employed to train relation between positive symbol and faces of populations of African descent. This article was excluded as the topic of racism is a very complex topic and this review does not want to reduce it to a matter of preference.

Discussion

The overall result from the studies included in the review point that the equivalence classes can influence preferences. In all the studies, most of the participants (X of Y) have chosen the objects which belonged in the same class as the positively valenced stimuli. It is valid for the experiments conducted with children as well as adults and training structure. There are some differences between studies in what percent of the participants have chosen the objects with the stimuli which were meant to demonstrate the transfer of function. For some studies it was 55% of the participants (Arntzen, Eilertsen, et al., 2016), 62% (Eilertsen & Arntzen, 2017) and for others as high as 90% (Santos & Rose, 2018; Smeets & Barnes-Holmes, 2003).

There are many aspects which play a role in that. One important point to be made is that the preference arguably can change depending on the motivational operations. In some of the

studies, the participants chose object which for them were preferable in contrast what was expected by experimenters. For example, in Arntzen, Eilertsen, et al. (2016) experiment which resulted in 55% of the participants choosing the "sunny bottle" which is lower than in other studies included in the review. However, it is important to look at the setting of the study which was conducted during a heatwave in Norway which could lessen the lust for sun. One participant said that they chose cloudy symbol because it was too hot lately, hence the stimulus equivalent to the sunny weather symbol was avoided. In Barnes-Holmes et al. (2000) one participant explained the choice of CANCER brand by their astrological sign, two other participants reported that they have had terrible holidays (illness and a family loss) and chose the CANCER brand instead of HOLIDAYS. Those examples show that the experimental control in those experiments is especially prone to extraneous variables. The experiments which included the tailoring of the stimuli have tried to address this challenge and results are promising as in Santos and de Rose (2019), where all of the children chose to try first food with stimulus equivalent to their favorite character and later preferred the taste of it to other option. The study done with low potency begin-valenced stimuli (Arntzen, Eilertsen, et al., 2016) shows that the choice distribution among the neutral objects (dikes) was equal.

However, there is an important point to be made in the experiments where children tasted food and were rating it, the food was the same in all the containers. It would be beneficial to see if children would prefer a healthy snack in a package labeled with their favorite character over a sweet, sugary snack in a plain package. Or if a bottle of water, labeled with a favorite character would be chosen over a bottle of coke labeled with some arbitrary stimuli. In this way one could argue stronger that the preference can be changed. A new study could present firstly pretest

where children taste and rate different food alternatives: healthy with low sugar, medium with moderate and unhealthy with high sugar content. The food would be presented firstly with no labels. Then after the matching-to-sample procedure including negatively and positively valenced-stimuli the children would be presented with the choice again. This time the stimulus equivalent to the positively valenced stimuli would be placed on the food rated lowest in the pre-test and negatively/valenced stimuli on the food rated highest in the pretest. This experiment would arguably present stronger arguments for alternating preferences if the results showed that low sugar food rated low in the pretest has been rated higher in the post-test even though the food was less attractive in the first place.

Another question is to be made of the role of question in those kinds of experiments. In the study by Keenan et al. (2020) the participants were told that the B1 stimulus was "a good person", later when the experiment tries to reverse the social function the participants were told "sorry I have made a mistake. YIM was actually a bad person not a good person." This way of phrasing information could be easily interpreted as instruction by the participants. The authors argue in their article that this way of phrasing was to match the colloquial use of English in Northern Ireland and that the aim of the study was to see how stimulus equivalence can affect social interactions. Those arguments do not entirely address the fact that the instruction given to the participants could work as a directive to change their previous responses. Another challenge is with prompting for the answers for the preferences. In the study Smeets & Barnes-Holmes (2003) the children in conditions five and six were asked which lemonade they preferred. From six children only one chose a favorite drink immediately. The remaining five hade to be prompted for a forced choice. Some of the children answered that they "taste the same" and "I

like them both" (the lemonade was the same in all of the containers). The prompt was given in a sentence "*I am sure one tasted a little but better than other? Which one would that be?".* A question like that is probably highly suggestive for children and could be interpreted that their original response was not correct or not as expected. This brings us to a broader topic of the importance of instructions in the experiments on the stimulus equivalence. The instructions are said to have an important role for establishing the conditional discrimination during the training. The words "belong together used in the relation to the stimuli AB can help correct responding occur under conditional discrimination (Arntzen, 2012). On the other hand, the phrases used in the experiment "*the tasks are interrelated*", "*continue to respond in a way that you consider correct"* give a clue how to respond to the participants. Even simple phrase "try your best" can facilitate responding in the test phase of the experiment based on their previous responding in the conditional discrimination training. It can be argued that the instruction in this form facilitate the derived transfer. (Dymond & Rehfeldt, 2000).

This review includes only studies written in Norwegian or English and therefore is limited. The search could be expanded with studies done in other languages. In the current literature review the articles were found by the biggest databases in the field of psychology which includes most of the journals, however more journals could be searched such as: *European Journal of Behavior Analysis (*EJOBA), *Behavioural Processes* (BP), *the Quarterly Journal of Experimental Psychology* (QJEP), *Psicologia: Relexão e Crítica* (PRC) and *Research in Developmental Disabilities (RiDD)*. Excluded studies in this review such as *Derived relations and generalized alteration of preferences* (Valdivia-Salas et al., 2013) and *A derived transfer of mood functions through equivalence relations* (Barnes-Holmes et al., 2004) which incorporated

paring one of the stimuluses within equivalence class could further help to answer the question on the alternation of preferences as a function of equivalence classes.

Conclusion

The effects of emerged equivalence classes and the influence they have on preference has relatively short research history and few studies have been conducted. Based on the papers included in the review the transfer of function in equivalence class demonstrates an effect on the preference. In all the ten papers the evidence of preference for the products labeled with the stimulus equivalent to the positively valenced stimuli shows potential for forming preferences. This can have application in commercial use as well as in education, forming preferences toward environmentally friendly solutions or healthy food.

References

Arntzen, E. (2012). Training and Testing Parameters in Formation of Stimulus Equivalence: Methodological Issues. *European journal of behavior analysis*, 13(1), 123-135. https://doi.org/10.1080/15021149.2012.11434412

Arntzen, E., Eilertsen, J. M., & Fagerstrøm, A. (2016). Preferences in equivalence classes by low potency benign valenced stimuli. *European journal of behavior analysis*, *17*(2), 142-153. https://doi.org/10.1080/15021149.2016.1247637

Arntzen, E., Fagerstrøm, A., & Foxall, G. R. (2016). Equivalence classes and preferences in consumer choice. In *The Routledge Companion to Consumer Behavior Analysis* (1 ed., pp. 65-77). Routledge.

Barnes-Holmes, D., Keane, J., Barnes-Holmes, Y., & Smeets, P. M. (2000). A derived transfer of emotive functions as a means of establishing differential preferences for soft drinks [Learning & Memory 2343]. *The Psychological Record, 50*(3), 493-511. http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=psyc3&NEWS=N&AN=2000-02367-005

Barnes-Holmes, Y., Barnes-Holmes, D., Smeets, P. M., & Luciano, C. (2004). A Derived Transfer of Mood Functions through Equivalence Relations. *Psychological Record, 54*(1), 95.

Dixon, M. R., Enoch, M. R., & Belisle, J. (2017). Transfers of stimulus function during roulette wagering. *J Appl Behav Anal, 50*(4), 819-824. https://doi.org/10.1002/jaba.417

dos Santos, S. L. d., & de Rose, J. C. C. d. (2018). Investigating the Impact of Stimulus Equivalence on Children's Food Choice and Preference. *Trends Psychol, 26*(1), 1-14. https://doi.org/10.9788/tp2018.1-01

dos Santos, S. L., de Rose, J. C., & de Rose, J. C. (2019). Influence of Cartoon Characters on Children's Food Preference Via Transfer of Functions. *The Psychological record, 69*(2), 153-163. https://doi.org/10.1007/s40732-018-0327-7

Dougher, M. J., Augustson, E., Markham, M. R., Greenway, D. E., & Wulfert, E. (1994). THE TRANSFER OF RESPONDENT ELICITING AND EXTINCTION FUNCTIONS THROUGH STIMULUS EQUIVALENCE CLASSES. *J Exp Anal Behav, 62*(3), 331-351. https://doi.org/10.1901/jeab.1994.62-331

Dougher, M. J., & Markham, M. R. (1996). 8 Stimulus classes and the untrained acquisition of stimulus functions. In T. R. Zentall & P. M. Smeets (Eds.*), Advances in Psychology* (Vol. 117, pp. 137-152). North-Holland. https://doi.org/https://doi.org/10.1016/S0166-4115(06)80107-X

Dymond, S., & Rehfeldt, R. A. (2000). Understanding complex behavior: The transformation of stimulus functions. *The Behavior analyst, 23*(2), 239-254. https://doi.org/10.1007/BF03392013

Eilertsen, J. M., & Arntzen, E. (2017). Overføring av Stimulusfunksjoner. *Norsk Tidsskrift for Atferdsanalyse 44*(Nummer 2 VINTER 2017), 33 - 49.

Eilertsen, J. M., & Arntzen, E. (2020). Tailoring of painful stimuli used for exploring transfer of function [Sensory Perception 2320]. *The Psychological Record, 70*(2), 317-326. https://doi.org/http://dx.doi.org/10.1007/s40732-020-00381-7

Fields, L., Arntzen, E., & Doran, E. (2020). Yield as an Essential Measure of Equivalence Class Formation, Other Measures, and New Determinants. *The Psychological Record*, 70(2), 175-186. https://doi.org/10.1007/s40732-020-00377-3

Gross, A. C., & Fox, E. J. (2009). Relational Frame Theory: an overview of the controversy. *The Analysis of Verbal Behavior*, *25*(1), 87–98. https://doi.org/10.1007/BF03393073

Keenan, M., Schenk, J., Coyle, C., Reid, L., & Gallagher, S. (2020). The effects of social labels on the allocation of resources to equivalent stimuli: Does one rotten apple spoil the whole barrel? [General Psychology 2100]. *The Psychological Record*, No-Specified. https://doi.org/http://dx.doi.org/10.1007/s40732-020-00423-0

Mizael, T. M., de Almeida, J. H., Silveira, C. C., & de Rose, J. C. (2016). Changing racial bias by transfer of functions in equivalence classes [Psychosocial & Personality Development 2840]. The Psychological Record, 66(3), 451-462. https://doi.org/http://dx.doi.org/10.1007/s40732-016-0185-0

Moss-Lourenco, P., & Fields, L. (2011). Nodal structure and stimulus relatedness in equivalence classes: Post-class formation preference tests [Human Experimental Psychology 2300].

Journal of the Experimental Analysis of Behavior, 95(3), 343-368. https://doi.org/http://dx.doi.org/10.1901/jeab.2011.95-343

Sidman, M., & Tailby, W. (1982). Conditional discrimination vs. matching to sample: an expansion of the testing paradigm. *Journal of the experimental analysis of behavior, 37*(1), 5–22. https://doi.org/10.1901/jeab.1982.37-5

Sidman, M. (1994). *Equivalence relations and behavior : a research story*. Authors cooperative.

Sidman, M. (1997). EQUIVALENCE RELATIONS. J Exp Anal Behav, 68(2), 258-266. https://doi.org/10.1901/jeab.1997.68-258

Sidman, M. (2009). Equivalence relations and behavior: an introductory tutorial. *Anal Verbal Behav, 25*(1), 5-17. https://doi.org/10.1007/BF03393066

Sidman, M. (2018). What Is Interesting About Equivalence Relations and Behavior? *Perspectives on Behavior Science, 41*(1), 33-43. https://doi.org/10.1007/s40614-018-0147-8

Smeets, P. M., & Barnes-Holmes, D. (2003). Children's emergent preferences for soft drinks: Stimulus-equivalence and transfer [Consumer Attitudes & Behavior 3920]. *Journal of Economic Psychology, 24*(5), 603-618. https://doi.org/http://dx.doi.org/10.1016/S0167-4870%2803%2900004-7

Valdivia-Salas, S., Valdivia-Salas, S., Dougher, M. J., Dougher, M. J., Luciano, C., & Luciano, C. (2013). Derived relations and generalized alteration of preferences. *Learn Behav*, 41(2), 205-217. https://doi.org/10.3758/s13420-012-0098-y

Table 1

An Overview over all the Studies Included in the Review

Authors and year	Participants	Training structure	How was the preference influenced?	Finding
Arntzen, Eilertsen, et al., 2016	40 28 Female 12 Male Average age 25	SMTS OTM AB/AC	One group with symbols of sunny, cloudy, and rainy weather. Second group with similar dikes.	Established preference by training a specific function to the nodal stimuli in equivalence class. 55% chose symbol equivalent to the "Sunny wearther".No difference in preference among dikes.
Arntzen, Fagerstrøm, et al., 2016	16 3 Female 13 Male Average age 27	DMTS OTM AB/AC	Three emoticons: a smiley, neutral and sad	13 from 16 participants preferred a bottle with a symbol which was in the same equivalence class as a smiley face during training
Barnes-Holmes et al., 2000	38 30 Male 8 Female Age 18-25	DMTS AB/BC	Training of two equivalence classes. Once including word HOLIDAYS and second CANCER	Most of participants preferred beverage with the symbol from HOLIDAY equivalence class. When the symbols were interchanged the preference changed accordingly.

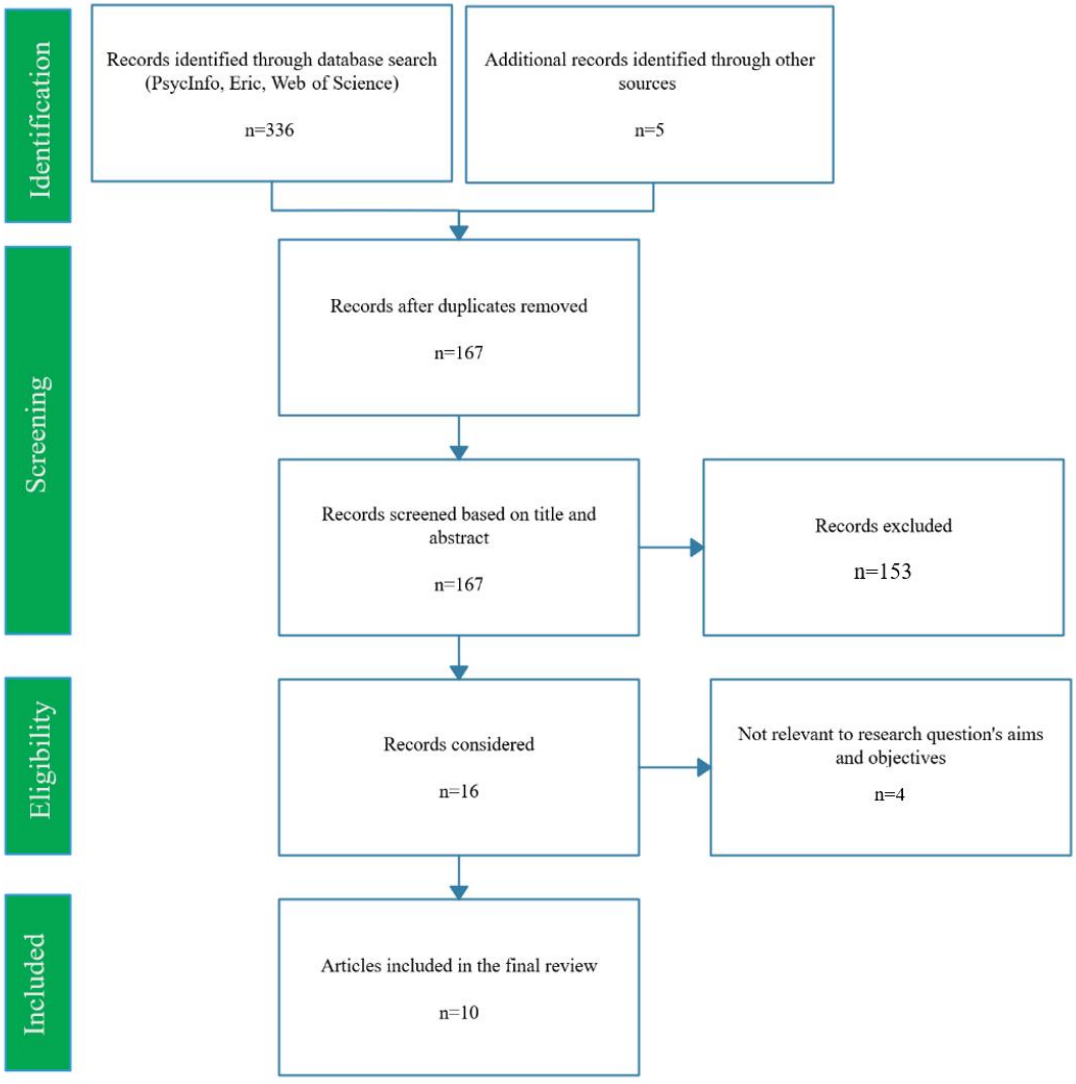
Authors and year	Participants	Training structure	How was the preference influenced?	Finding
dos Santos et al., 2019	20 13 Female 7 Male Age 5 to 36	SMTds Simple-to-complex AB/BC	Including favorite and disliked cartoon character into the equivalence classes	Children preferred food with symbol equivalent to their favorite heroes. Children preferred food with disliked character over food labeled with abstract symbol
Eilertsen & Arntzen, 2017	17 7 female 10 Male Average age 28	SMTS OTM AB/AC	Expanding class by assigning too the class members the banknotes of different value (50, 100 and 200)	62 % has chosen the bottle corresponding to the banknote with the highest value
Eilertsen & Arntzen, 2020	15 11 Female 4 Male Average age 26,5	SMTS OTM AB/AC	Self-assessed pictures of most- and least painful stimuli.	Participants avoided bottles with symbols equivalent to the most painful stimulus
Keenan et al., 2020	5 2 Female 3 Male Age between 21 -23	SMTS OTM AB/AC	Adding positive and negative social label to the stimuli	Most token allocated to the stimulus with positive social label, other members of the class received more tokens comparing to the other class members.

Authors and year	#Participants	Training structure	How was the preference influenced?	Finding
dos Santos & de Rose, 2018	12 3 Female 9 Male Age between 5 -6	DMTS AB/BA BC/CB	Including favorite and disliked cartoon character into the equivalence classes	90% of children chose first the food with symbol equivalent to the favorite character, 80% reported that it tested better. In test to 90% preferred novel symbol over disliked character
Smeets & Barnes-Holmes, 2003	16 6 Female 10 Male Age 5.3 – 5.8	DMTS A-B, B-C other group B/A, C/B	Picture of a smiling cartoon character and in the other class picture of a crying baby	90% of children tired first the drink with label equivalent to the smiling character. 90% also preferred the taste of this drink
Dixon et al., 2017	25 16 female 9 male	DMTS AB/AC	Placing bets on red or black. Pairing the colors with positive or negative words	21 of 25 participants showed greater allocation to the color paired with positive words.

Note. The table shows the participants of each experiment, training structure: Delayed matching-to-sample (DMTS), simultaneous matching to sample (SMTS), OneToMany (OTM)

Figure 1

Flowchart Presenting Steps of the Database Search Process



Transfer of Function and Its Influence on Preferences

Abstract

The goal of the present experiment was to study the effect of transfer of function on preferences. Fifteen participants were presented with a choice of a soda can with stimuli on the cans which later were used as B stimuli. Next, the participants went through matching-to-sample training arranged in one-to-many training structure (AB/AC) and tested for the emergence of three-3-member equivalence classes. Then a new stimulus was introduced to each equivalence class in a form of written word GOOD (D1), NEUTRAL (D2) and BAD (D3). Each of the new D stimuli were trained to the A1, A2 or A3. Next the participants went through test for equivalence relations with the expanded classes and then were presented with the same soda cans and asked which they prefer and why. After the participants made their choice two more choice situations were presented, first between three cars and in the end with three mobile phones. The objects had B1, B2 or B3 stimulus on them. The results show a change in the preferences in selected objects after the emergence of equivalence classes with positively and negatively valenced stimuli.

Keywords: choice, derived relations, equivalence class, emergent relations, preference, stimulus equivalence, transfer of function

Transfer of function and Its Influence on Preferences

The power of symbols is not to be underestimated, we might be unaware of it, but we are experiencing it throughout the day. The words spoken to others, which are a form of a symbol representing the thing they refer to can affect people as if they were the things they refer to. Murray Sidman wrote:

> Examples of nonverbal symbols becoming equivalent to events and things in reality abound: advertising agencies have long recognized and promoted the equivalence of automobile size and penis size; changing a company's logo is expected to change the company itself, transforming it from an economic failure to a success; "clothes make the man". (Sidman, 2018, p. 36)

It accounts for trivial things such as worries of a teenager about brand of their shoes as well as the question of life and death where in some parts of the world people risk their lives for carrying religious symbols of their faith. The phenomena that a symbol can have the same meaning as the thing it represents is well demonstrated by stimulus equivalence. The concept was developed by Murray Sidman who worked at an institution with boys with intellectual disabilities. Sidman (2009) describes his work with the boys could not read, and conventional ways of teaching were not effective. Therefore, the personnel taught at first to match spoken words to pictures. This auditory-visual matching was a first step. Let's say that a spoken word was presented CAR as stimuli A1, then the boys had to choose between several pictures a CAR (stimulus B1), a CAT (stimulus B2), a COW (stimulus B3), or a DOG (stimulus B4). The selection of the image representing a car (B1) resulted in reinforcement. This conditional discrimination training was then continued with all the rest of the words which were presented as

comparison stimuli. This led to establishing relations A1 is equal B1, A2 is equal to B2 and so on. When the boys could match spoken words to pictures the learning continued with teaching the dictated words to written words. When presented with a spoken word CAR (A1) they had to match it to written words CAR (stimulus C1), CAT(B2), COW (C3) or DOG (C4). The reinforcement was produced only if the right comparison stimulus was chosen. This way the boys could match spoken words to written and established a relation A1 is the same as C1, B2 is equal to C2 and so on. The boys have learned that A=B and A=C. Then the boys were presented with written words which had to be matched to pictures. This relation was not directly trained and results in relation B=C where a written word CAR must be matched with a picture of a car. For the boys with disability and learning difficulties that was a big achievement. An emergence of new relation which was not taught. The printed words became symbols for the pictures, the spoken and written words became equivalent to the pictures and formed an equivalence class where the stimuli are interchangeable.

The studies on stimulus equivalenced continued, Barnes-Holmes et al. (2000) have conducted three experiments where participants were trained to form three-member equivalence classes. The first class contained word “CANCER” a nonsense syllable “VEK” and word “BRAND X”. The other class included word “HOLIDAYS” a nonsense syllable “ZID” and a word “BRAND Y”. The participants after they were tested for emergence of the equivalence classes were asked to taste two colas and rate them. One with a label “BRAND X” and the other with a label “BRAND Y”. The aim of the study was to see if the meaning of the words “CANCER” and “HOLIDAYS” could transfer to the other members of the class influencing, the ratings of the taste. They observed that the participants have rated the drinks labeled with “BRAND” X higher than those with “BRAND Y”.

We identify people on the streets with different groups (probably not as often correctly as we think) based on their tattoos, clothes, or items they carry. A young person sitting on a bench with creased clothes and an empty cup of coffee can be a beggar at first glance, but we change empty coffee cup for a saxophone, and some will see a tired musician after a long night jamming session. Our perception of reality can change through small things. A design of logo can change how perceive the attractiveness of the brand and their products (Munawaroh, 2015; Rafiq et al., 2020).

Some brands develop very strong image and branding which leads to their success. Arguably one of the best examples can be Apple which is visible on the electronics market since many years. Its strong brand can also be seen in numbers. From launching its iPhone in 2007, Apple has been leading in the profits of the mobile phone industry with well over 50% of global profit shares of mobile phones. What is even more astonishing is that apple from years does so with less than 20 % of mobile phone market share measured by sold units (Buisson, 2012; Chauchan, 2019). How come that a company which has less than 20% of the market gains most profit? Some points to the loyal brand premium users which secure Apple a steady inflow of revenue (Chauchan, 2019). In this example one can ask if the customers have developed stronger relationship to the product or to the company as a brand.

Companies' brands account for over 60% of the value of global organizations (McDonald & Mouncey, 2009 in Arntzen et al., 2016). It also points how preference to a brand is important as the preference for a brand related to the possible purchase. Arntzen et al., (2016) summarizes the models in customer-based brand equity research as a conceptualization of associations as a set of nodes and links. There is a number of studies (Arntzen, Eilertsen, et al., 2016; Arntzen,

Fagerstrøm, et al., 2016; Barnes-Holmes et al., 2000; Eilertsen & Arntzen, 2017, 2020; dos Santos & de Rose 2018,2019) which looked how the preference can affect the preferences by training a specific function to the nodal stimuli in equivalence class.

The purpose of the present study was to examine how the preference is affected by emergence of the equivalence classes. In some of the previous studies done on the same topic (dos Santos & de Rose, 2019; dos Santos & de Rose, 2018; Smeets & Barnes-Holmes, 2003) there is a division between the terms choice and preference – the choice was regarded to which of the objects were selected first among while preference referred to the participants liking of the different food after they tried them and rated themself. Since there is no tasting in the present article and the choice of the objects will be considered equivalent to preference and hence both words are used interchangeably.

Many studies (Arntzen, Eilertsen, et al., 2016; Arntzen, Fagerstrøm, et al., 2016; Eilertsen & Arntzen, 2017, 2020; dos Santos & de Rose 2018,2019) on the topic of the transfer of function and preferences have similar structure where first a conditional discrimination training is employed to train relations between two or three groups of stimuli. Once the participants respond according to the programed consequences a test for equivalence is initialized. The participants who passed the test are then presented with new conditional discrimination training where a new D-stimuli are introduced. The experiments depending on the number of equivalence classes use a positively valenced stimuli, neutral and negatively valenced stimuli. In the mentioned studies where three 4-member equivalence classes emerged the positively valenced stimuli like a smiley face (Arntzen, Fagerstrøm, et al., 2016), high value banknote (Eilertsen & Arntzen, 2017), sunny weather symbol (Arntzen, Eilertsen, et al., 2016) or a favorite cartoon character (dos Santos & de

Rose 2018,2019) were used. The neutral stimuli or stimuli valenced lees positively were used such as neutral face (Arntzen, Fagerstrøm, et al., 2016), banknote of lower value (Eilertsen & Arntzen, 2017), partially cloudy weather symbol (Arntzen, Eilertsen, et al., 2016), and abstract symbol (dos Santos & de Rose 2018,2019) while a negatively valenced stimuli were presented in for of a sad face (Arntzen, Fagerstrøm, et al., 2016), low value banknote (Eilertsen & Arntzen, 2017) or), rain/storm weather symbol (Arntzen, Eilertsen, et al., 2016) and a least favorite cartoon character (dos Santos & de Rose 2018,2019). The new, valenced stimuli in those experiments were only trained to one member from each previously emerged equivalence classes. After a person reached set training criteria all the relations in the class were tested. The experiments then run a preference test where the participants are presented with a choice situation. In the choice situation there are three objects which display a stimulus from each equivalence class. The stimuli displayed on the object in the preference test was one that was not directly trained to the D-stimuli/valenced stimuli. Some studies presented the participants with three identical bottles of water (Arntzen, Eilertsen, et al., 2016; Arntzen, Fagerstrøm, et al., 2016; Eilertsen & Arntzen, 2017) or food items in identical food containers (dos Santos & de Rose 2018,2019). The results of those studies show that the majority of the participants selects items which show stimuli which belon to the class together with positively valenced stimulus.

The experiment of the current study used the simultaneous protocol. The training structure was arranged in One-to-Many (OTM). There are some studies which find the OTM to be most effective training structure for the emergence of stimulus equivalence, although there are studies which point towards the Many-to-One (MTO) as a more effective training structure (Arntzen, 2012). However, there are studies which suggest that OTM training structure leads to

more correct baseline trials in the test (Ayres-Pereira & Arntzen, 2017) and therefore OTM training structure was employed. The experiment used simultaneous matching-to-sample (SMTS) for the presentation of the stimuli, which means that the sample stimulus is presented first with the comparison stimuli later – all the stimuli stay presented together as long as the participant select the comparison stimulus.

Method

Participants

Fifteen participants took part in the experiment which of 8 were females and 7 males. The age of participants varied from 26 to 42 with 34 years being the average. The participants were recruited through personal contacts and none of them had any previous knowledge of stimulus equivalence. All were asked to read a consent form where they were informed that their results would not be traceable to their person and learnt of their right to withdraw from the experiment at any moment without any negative consequences. They were also informed that the duration of the experiment is approximately two hours and that after the completed experimental session they will be debriefed and will have possibility to see their results. The present experiment was not required for approval at the Norwegian Data Protection Authority (NSD) as there were no personal data collected from the participants, the names were not stored at any point and the participants were assigned a number at the start of the experiment. The results from each f the session were not traceable to the participant.

Setting and Apparatus

The experimental sessions were conducted through Zoom – an online videocall application. In the recruitment process all the participants were asked to find a quiet place for the duration of the experiment and reserve approximately two hours of none disturbed work. The participants were invited to a closed meeting and given the remote control over the customized matching-to-sample software program running on the experimenter's computer. The matching-to-sample software program presented a sample stimulus in the middle of the screen. The participants had to click on the sample stimulus in order to view three comparison stimuli which appeared in randomized order in the corners of the screens. The MTS program registered all the responses and the time it took from the presentation of the comparison stimuli and the response.

During the trials both the participant conducting the experiment as well as the participants had their camera and microphone switched off except for the pre- and the postest phase. The experiment was run on HUAWAI Matebook X computer, with Intel Core i5 on the experimenter side. The computers of the participants were varying.

Stimuli

Figure 1 shows the stimuli used in conditional discrimination training to form three equivalence classes. All the classes consist of stimuli of arbitrary relations. Figure 2 shows stimuli used in Phase two – the class expansion class phase. Figure 3 shows the cans used for preference test. The cans have been painted red and the stimuli presented on them were printed on white paper. In the posttest another randomized picture of the same cans was presented. In addition, two more pictures were given: three identical cars (Figure 4a) where each of them had

either B1, B2 or B3 stimulus on their car hood, three mobile phones (Figure 4b) where each of them had either B1, B2 or B3 stimulus on their screen.

Design

The experiment was conducted as a one-group pretest/posttest design. The independent variable was valenced words which were used in the conditional discrimination training and emergence of equivalence classes. The dependent variable were the choices made during the posttest. The experiment had five phases and ended with debriefing. See Figure 5 for an overview of the phases.

Procedure

Phase 1: Pretest for preference

After the participants have signed the consent, they were presented with one image of three cans which had been labeled with B stimuli (Figure 3) which served the role of a pretest for preference. The position of the cans in the picture were randomized — there were in total six images of the cans, one image for each possible combination in which the cans could be presented next to each other. The image for each experimental session was randomly chosen by the experimenter beforehand. After the participant selected a can, their choice was noted.

Phase 2: Conditional Discrimination Training

Next the participants were presented with a screen of a matching-to-sample program where they could read instructions for their task. The instructions were as following:

> This is an experiment in the field of learning psychology and requires no prior computer-knowledge. Once the experiment starts there will appear some stimuli

on the screen. When you move the cursor on the stimulus in the middle of the screen and click on it, three more stimuli will appear in the corners of the screen. Clicking the correct one will result in the written words "Correct" or "Good" on the screen. The goal is to get as many correct choices as possible. If you click on the wrong one, the word "Wrong" will appear. In this way you will find out what is right and wrong. After some time, words will not appear anymore, but you should just keep continuing. Remember to always click on the stimulus in the middle before you click on the ones that appear in the corners. Do not use phone or any other objects like paper or pen during the experiment. Good Luck

After reading the instructions the participants were asked if they had any questions. In case of some unclarity the experimenter read the relevant part of instruction again without adding any new information. Once the participant said they were ready to start, both the experimenter and participant muted themself and the control of the matching-to-sample program was given to the participant. Once the participant initiated the program a stimulus appeared in the middle of the white screen. Clicking it led to three more stimuli appearing in the corners of the screen. At each trial one of the corners of the screen remained empty — the position of the empty corner was changing randomly during the experiment. If the participant has chosen the correct comparison stimuli one of the following programmed consequences appeared: “Good”, “Accurate”, “Excellent”, “Well done” or “Awesome”. The programmed consequences appeared for 1000ms in the center of the screen. After that an intertrial interval of 500ms followed with blank white screen. The conditional discrimination training was conducted in One-To-Many training structure – AB/AC with the six relations trained: **A1**/B1-B2-B3, **A2**/B1-B2-B3, **A3**/B1-

B2-B3, **A1**/C1-C2-C3, **A2**/C1-C2-C3, **A3**/C1-C2-C3. The sample stimulus is highlighted in bold and the correct comparison stimuli is underlined. Each relation was trained five times leading to blocks of 30 trials. Simultaneous protocol was used with trials presented concurrently. After achieving 95% or more correct responses the MTS software, initiated thinning of programmed consequences from 100% to 75% in one block of 30 trials. Later it went to 25% and in the end 0%. After that, the test for stimulus equivalence was initiated under extinction conditions therefore during the test there was no feedback for the responses. It tested 30 trials of baseline, symmetry, and equivalence relations – 90 in total. If the participant achieved 95% or more on the test, they went to Phase 2. In case the number of the correct responses was lower than the criteria, the participant was debriefed and thanked for their participation.

Phase 3: Class Expansion

The experimenter loaded parameters in the MTS program where the new members of the class were introduced – stimuli D (Figure 2). The valenced stimuli in form of D1 (GOOD), D2 (NEUTRAL) and D3 (BAD) were trained to the nodal stimuli. The training structure was D1/A1, A2, A3, and D2/A1, A2, A3 and D3/A1, A2, A3. The conditional training in this phase lasted until the participant has achieved 95% or more correct responses.

Phase 4: Test for Equivalence Class Formation

That was the final phase with the MTS program. The participant was tested for three-4-members equivalence classes. The test consisted of 180 trials which tested the same relations as in Phase two with addition of: baseline relations **D1**/A1-A2-A3, **D2**/ A1-A2-A3, **D3**/ A1-A2-A3, symmetry: **A1**/ D1-D2-D3, **A2**/D1-D2-D3, **A3**/D1-D2-D3, transitivity **D1**/C1-C2-C3, **D2**/C1-

C2-C3, **D3**/C1-C2-C3, **D1**/B1-B2B3, **D2**/B1-B2-B3, **D3**/B1-B2-B3, and equivalence trials **C1**/D1-D2-D3, **C2**/D1-D2-D3, **C3**/D1-D2-D3. **B1**/D1-D2D3, **B2**/D1-D2-D3, **B3**/D1-D2-D3. If the participant has scored 95% of more correct responses, they were asked questions for preference in the posttest.

Phase 5: Posttest for Preferences

The experimenter unmuted the program and asked the participant to do the same. Cameras remained switched off. The posttest started with an image of three cans in a randomized order. Then the experimenter asked the question: "which can do you prefer?". The answer was written down by the experimenter and the second question followed "why did you prefer this can?". The answer was registered, and the participant was then presented with second picture of three identical cars – the cars had one of the B stimuli on their hoods followed by the question "which car do you prefer". After the participant chose the car, they were asked why they made that choice. Finally, they were presented with a third picture of three mobile phones with one of the B stimuli on the screen. They were asked the question – "which mobile phone do you prefer".

After the answers were registered the participants were thanked and debriefed. They were explained what stimulus equivalence is and what are the objectives for the study they participated in. All participants were offered a possibility to see their results. Any questions from the participants' side were answered.

Results

Fourteen out of 15 participants formed stimulus equivalence with the criterion set in the experiment. The results of those fourteen participants are presented in Table 1 (the data does not include participant 18361 as they did not meet the set criteria, they tested under 95% on the test for stimulus equivalence). The number of trials to establish the three-3-member classes varied from 150 to 450 with the mean of 272 trials. In the class expansion phase, all participants who passed Phase 1 formed three 4-member classes. It took between 60 and 105 trials with the average of 77. In the pretest for preferences only three participants chose the can with B1 symbol – the symbol which later was in the same class as the word GOOD.

In the posttest the number of participants who chose can with B1 was eight. This shows an increase in preference for cans with B1 symbol from 21% to 57%. At the same time in the pretest 9 participants chose the can with B3 symbol which was in the same class as word BAD. In the posttest it was only four participants who chose can with B3 symbol which is a decrease from 64% to 29%. The difference is even more visible if we include the car and mobile phone choices (see Figure 7). In total 24 choice situations resulted in selecting objects with B1 symbol which is 57% of the total choices (14 participants with three choices each).

One can summarize the results of the preference change for cans in the following way: there was an increase in the preference for cans with B1 symbol, no change in the preference for cans with B2 symbol and a decrease for cans with B3 symbol. The results for preferences including car and mobile phones shows that the preference for objects with symbol B1 was the highest with 57% of choices being placed on objects with this symbol. From the 9 participants who chose symbol B3 in the pretest, 8 has changed their preference in the posttest. However,

there is also observed stronger preference for objects with symbol B3 comparing to B2 which was in the same class with word NEUTRAL. Participants who chose objects labeled with B3 reported that they have done so because it was the “easiest”, “symmetrical”, “esthetic” and “minimalistic” symbol.

Discussion

The aim of this experiment was to investigate if the formation of equivalence class with differently valenced words can influence the preference in choice situation. The result of the study indicate that majority of the participants preferred the objects with symbol which was in the same group as the word GOOD which replicated previous studies which are included in the first article of the current master thesis, showing that a symbol equivalent to the positively valenced stimulus will be chosen more frequently (Arntzen, Eilertsen, et al., 2016; Arntzen, Fagerstrøm, et al., 2016; Barnes-Holmes et al., 2004; Dixon et al., 2017; dos Santos & de Rose, 2018, 2019 ; Eilertsen & Arntzen, 2017, 2020; Keenan et al., 2020) .

Although there are some differences between participants’ responding, the overall trend confirms previous studies showing decrease for negatively valenced stimuli and increase in the preference for positively valenced. There is however a need to look further into variables which influenced the decisions where participants preferred objects with the symbols from group NEUTRAL and BAD. There are some possible explanations which come from participant’s self-reports during the posttest when they were asked why they chose the object. Many who chose objects with B3 symbol reported that they have done so because it was their “symmetrical”, “esthetic” and “minimalistic” symbol. One could argue that the familiarity and simplicity of the B3 symbol which is a round shape could affect the choice situation. It would be interesting for

future studies to replace B3 symbol with a stimulus more abstract and irregular in shape. One could argue that placing a theta symbol on a can of coke could resemble a product which is very popular (Coca-Cola Zero) and therefore some participants might have had already established preference for it. Another thing to point out with the symbol B3 is that during the experiment the participant number 18363 reported that they chose this symbol because it is a mathematical symbol *theta* frequently used in theirs work and has positive relation to it. It might be that because this symbol was not abstract for the participant, and they already had an established preference for it therefore affecting the results of the experiment. Even if the symbol was equivalent to "BAD" the participant had learning history where this symbol had positive discriminative function. Interestingly it was the only participant who chose B3 symbol in all of the tests. The importance of the discriminative function in stimulus equivalence research can be referenced to the study by Watt et al. (1991) where participants with religious protestant background had difficulties to establish equivalence class with nonsense syllables, catholic names, and protestant symbols.

Another explanation from the self-reports is that participants reported they felt being manipulated during the choice situation. In the posttest, four participants (18364, 18368, 18370 and 18372) who chose B3 symbol in the posttest reported that they did so because they do not want to be manipulated or be influenced by the experiment. They reported that they felt compelled/expected to choose symbol equivalent to GOOD. This also can give a possible explanation why the NEUTRAL stimulus was chosen in the posttest.

The self-reports in the past were disregarded and referred as invaluable data by the of behavioral analysists, but with the work on areas of stimulus equivalence and the rule-governed

behavior the attitude to collecting the verbal has become more open (Cabello & O'Hora, 2016). The verbal reports can be valuable part in the interpretation of the results but cannot be taken as an explanation of behavior, especially the value of the post experimental verbal reports has been questioned (Cabello & O'Hora, 2002,2016). Since we cannot be sure that the verbal reports reflect the private behavior, they should be looked at as a correlational level in the interpretation of the results. There are studies where the participants show a high correspondence between verbal and nonverbal behavior during conditional discrimination training (Vie & Arntzen, 2017). On the other hand, it has been shown that some participants show non correspondence between the MTS and self-descriptions of performance, where they score nearly perfectly during the MTS training, but they verbally estimate their performance as incorrect (Lane & Critchfield, 1996).

At this point we should also mention the experimenter effect, a term which is defined as the extent to which the data gathered by the experimenter deviates from the "actual" data. The influence research might have on the participants and the results of the research might stem from unintentional errors of observation, measurement, or analysis. It can also be the experimenters' characteristics like sex, age, cultural background, expectations which affect the participants (Kingsbury, 1978). It is a challenge which any scientific discipline is facing, especially if they include people as participants. The best strategy is to have an experimenter who are blind to the purpose of the study and conditions of the experiment (Kuipers & Hysom, 2014). It is also effective to minimize the contact between the participants and the experimentation (Kingsbury, 1978; Kuipers & Hysom, 2014). In the present experiment both the participants and the experimenter had muted their computers and switched off the cameras which decreased the potential influence by facial expressions to the minimum, the participants were not observed

during their responses. The only moments when the experimenter and the participants communicated was during pre- and post-test where all the participants were asked the same question. Another point which arguably strengthens the current study is that the participants where at their own homes, in front of their own computers, which made the experiment situation arguably more natural and comfortable for the choice situation for them than if it had been conducted at the university or a lab room. It is pointed by the Gilder & Heerey (2018) that the social experiments would benefit from a double-blind experimental design where neither the participants nor the researcher knows which condition the participants are undergoing until the experiment is over. There is evidence which shows that the experimenter's belief can alter the participants behavior (Gilder & Heerey, 2018). In the current experiment the experimenter knew the purpose of the study, but the questions asked to the participants where asked exactly the same and were scripted before to avoid any personal bias or manipulation.

In this experiment the criterion for correct responses was set to 95% to not include participants who would not respond to stimulus equivalence but established some systematic specific classes. That would be a situation where a participant would respond incorrectly in one relation for example **D3**/B1-B2-B3 choosing B2 instead of B3 consecutively. By setting the criteria of correct responses to 95% it allows only four wrong responses out of 90 trials in the test for equivalence class in Phase 1 and eight responses not in accordance with stimulus equivalence out of 180 responses in Phase 3 of the experiment. In this way we can rule out the possibility that some participants have established specific classes. Lower accuracy as a mastery criterion would not ensure the same certainty that some participants have established specific classes. The results

can contribute to the understanding of variables affecting emergence of stimulus equivalence as well as the influence stimulus classes can affect choice situations.

This experiment also expanded previous research (Arntzen, Eilertsen, et al., 2016; Arntzen, Fagerstrøm, et al., 2016; Barnes-Holmes et al., 2004; Smeets & Barnes-Holmes, 2003; Dixon et al., 2017; Eilertsen & Arntzen, 2017, 2020; Keenan et al., 2020; dos Santos & Rose, 2019; dos Santos & de Rose, 2018) by giving a multiple choice in the posttest. Most of the studies on the transfer of function give the participants in the posttest just one choice situation or multiple choice of the same objects (REFS). This experiment attempted to see if the preference would be towards the objects with the same symbol in different situations. The choice situations are also arguably different in the sense that a choice of a water bottle is probably done daily or weekly without big consequences. While the choice of mobile phone is done more rarely, is probably more thought for most of the users. Finally, the choice of the car is different and more serious in its consequences (being it economical and practical). In many of the previous studies the objects of preference were water bottles, beverage, or food (Arntzen, Eilertsen, et al., 2016; Arntzen, Fagerstrøm, et al., 2016; Barnes-Holmes et al., 2004; Smeets & Barnes-Holmes, 2003; Eilertsen & Arntzen, 2017, 2020; dos Santos & de Rose, 2019; dos Santos & de Rose, 2018).

Throughout this paper as well as in the literature from the first article the term *transfer of function* was used to describe the phenomena where variables applied to one class member in an equivalence class transfer to the rest of the members of this class. Sidman was critical to the term *transfer of function* as he deemed it unnecessary since it was a descriptive term which describes a presumed behavioral process and is used to explain behavior while needs an explanation (1994) Sidman opted for a mathematical conceptualization of the term and based it in the mathematical

set theory to describe this phenomena. It is therefore important to note that the term transfer of function is used clearly descriptive and not a way of explaining the phenomena.

Limitations of the study and further research

In the pretest for preference the stimulus B3 was reported by participants to be chosen because of its round shape and simplicity. Future studies might benefit from choosing stimuli which are equally abstract in their shape. The selection of B3 could be also under control of another stimulus. The matching-to-sample procedure does not have to reflect the relation between the sample- and the comparison stimulus. The matching can also be done by rejecting B2 in the presence of A1and rejecting B1 in the presence of A2 (McIlvane & Dube, 1992). Same participant can perform matching-to-sample by rejecting incorrect comparison and in other trials selecting correct comparison by learned relation. However, the observable behavior – selecting the comparison stimuli is reinforced regardless of which strategy the participants uses as long as the response is correct (McIlvane & Dube, 1992).

Another point to be made is that the selection of the objects did not have any consequences for the participants. By selecting the objects in the posttest, they did not make a purchase during the experiment. Hence the selection of the objects for most of the participants was a matter of seconds which might suggest that there was no elaborate decision making. It would be interesting to imagine what results would be if after some time of the experiment the participants would be offered a real object for taking part in the experiment, if they were presented with the choice between the same three cars how many participants would choose the "BAD".

Some additional measures of transfer of function could be included. One of them would be to ask participants to rate the taste of the drinks in the cans like it was done in earlier studies (Barnes-Holmes et al., 2000; dos Santos & de Rose, 2018; Smeets & Barnes-Holmes, 2003). However, the current covid-19 pandemic made it impossible to extend the study in this way due to various restrictions.

To show the experimental control the study could include a group of the participants which would go under additional training after the last phase. In the additional training the D stimuli could we switched between the classes like in Barnes-Holmes et al., (2000). If the function of the reversed D-stimuli would transfer to the B-stimuli the experiment would have a better way of presenting the experimental control.

There is also a question to what extend those findings are relevant to the world outside the laboratory setting. The arbitrary matching procedure in an experimental setting might have evoke responses in the choice situation which would not occur in a more complex setting. The participants went through intensive matching-to-sample training during around two hours, with hundreds of responses and at the end they were asked which object they would prefer. Self-reports of feeling of manipulation are clearly understandable since the setting of choice situation is placed after long conditional discrimination training. Even if we are bombarded with ads throughout the day, we do not make a choice in a supermarket preceded by an extensive conditional discrimination training. It could be beneficial to divide the experiment into two parts with some days of interval. The first part would be phase one to four of the current experiment. Leaving the posttest for preference in the second part which would take after some days or

maybe even weeks. That could probably decrease the experienced manipulation/expectation in participants during the choice situation.

Conclusion

In the current study fourteen out of fifteen participants showed emergence of stimulus equivalence. Their choice for beverage can has been changed after the experimental session. A preference increase for can marked with the stimulus equivalent to the GOOD sign has been increased from three to eight participants, at the same time a reversed effect was observed for the stimulus equivalent to BAD sign where the number of participants choosing this can dropped from nine to four. The current research introduced a novelty of presenting different objects as a continuation of the preference test. The results are similar with increase from pretest from 20% to 57% for objects equivalent to GOOD stimulus and a decrease from over 60% to under 30% in objects labeled with stimulus equivalent to BAD.

References

Arntzen, E. (2012). Training and Testing Parameters in Formation of Stimulus Equivalence: Methodological Issues. *European journal of behavior analysis*, 13(1), 123-135. https://doi.org/10.1080/15021149.2012.11434412

Arntzen, E., Eilertsen, J. M., & Fagerstrøm, A. (2016). Preferences in equivalence classes by low potency benign valenced stimuli. *European journal of behavior analysis*, *17*(2), 142-153. https://doi.org/10.1080/15021149.2016.1247637

Arntzen, E., Fagerstrøm, A., & Foxall, G. R. (2016). Equivalence classes and preferences in consumer choice. In *The Routledge Companion to Consumer Behavior Analysis* (1 ed., pp. 65-77). Routledge.

Ayres-Pereira, V., & Arntzen, E. (2017a). Many-to-One versus One-to-Many: Training Structures and the Emergence of Three 7-member Equivalence Classes in Adults.

Barnes-Holmes, D., Keane, J., Barnes-Holmes, Y., & Smeets, P. M. (2000). A derived transfer of emotive functions as a means of establishing differential preferences for soft drinks [Learning & Memory 2343]. *The Psychological Record, 50*(3), 493-511. http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=psyc3&NEWS=N&AN=2000-02367-005

Barnes-Holmes, Y., Barnes-Holmes, D., Smeets, P. M., & Luciano, C. (2004, 01/01/). A Derived Transfer of Mood Functions through Equivalence Relations. *Psychological Record, 54*(1), 95.

Bernard Buisson, P. S. (2012). *Market invasions: a game for established players?* M Innovation Symposium -Stimulating Innovation: Challenges for Management, Science & Technology, , Seoul, Korea.

Cabello, F., & O'Hora, D. (2002). Addressing the limitations of protocol analysis in the study of complex human behavior. *International Journal of Psychology and Psychological Therapy, 2*, 115–130. http://www.ijpsy.com/

Cabello Luque, F., & O'Hora, D. (2016). Verbal Reports in the Experimental Analysis of Behavior. *International Journal of Psychology and Psychological Therapy, 16*(2), 157–177.

Chauchan, K. (2019). *Apple Continues to Lead Global Handset Industry Profit Share*. Retrieved 11-04-2021 from https://www.counterpointresearch.com/apple-continues-lead-global-handset-industry-profit-share/

Dixon, M. R., Enoch, M. R., & Belisle, J. (2017). Transfers of stimulus function during roulette wagering. *J Appl Behav Anal, 50*(4), 819-824. https://doi.org/10.1002/jaba.417

Dougher, M. J., Augustson, E., Markham, M. R., Greenway, D. E., & Wulfert, E. (1994). THE TRANSFER OF RESPONDENT ELICITING AND EXTINCTION FUNCTIONS

THROUGH STIMULUS EQUIVALENCE CLASSES. *J Exp Anal Behav, 62*(3), 331-351. https://doi.org/10.1901/jeab.1994.62-331

dos Santos, S. L. d., & de Rose, J. C. C. d. (2018). Investigating the Impact of Stimulus Equivalence on Children's Food Choice and Preference. *Trends Psychol, 26*(1), 1-14. https://doi.org/10.9788/tp2018.1-01

dos Santos, S. L., & de Rose, J. C. (2019). Influence of cartoon characters on children's food preference via transfer of functions [Psychosocial & Personality Development 2840]. *The Psychological Record, 69*(2), 153-163. https://doi.org/http://dx.doi.org/10.1007/s40732-018-0327-7

Dymond, S., & Rehfeldt, R. A. (2000). Understanding complex behavior: The transformation of stimulus functions. *The Behavior analyst, 23*(2), 239-254. https://doi.org/10.1007/BF03392013

Eilertsen, J. M., & Arntzen, E. (2017). Overføring av Stimulusfunksjoner. *Norsk Tidsskrift for Atferdsanalyse 44*(Nummer 2 VINTER 2017), 33 - 49.

Eilertsen, J. M., & Arntzen, E. (2020). Tailoring of painful stimuli used for exploring transfer of function [Sensory Perception 2320]. *The Psychological Record, 70*(2), 317-326. https://doi.org/http://dx.doi.org/10.1007/s40732-020-00381-7

Gilder, T. S. E., & Heerey, E. A. (2018). The Role of Experimenter Belief in Social Priming. *Psychological Science*, *29*(3), 403–417. https://doi.org/10.1177/0956797617737128

Keenan, M., Schenk, J., Coyle, C., Reid, L., & Gallagher, S. (2020). The effects of social labels on the allocation of resources to equivalent stimuli: Does one rotten apple spoil the whole barrel? [General Psychology 2100]. *The Psychological Record*, No-Specified. https://doi.org/http://dx.doi.org/10.1007/s40732-020-00423-0

Kingsbury, S. J. (1978). Robert Rosenthal, Experimenter Effects in Behavioral Research, Expanded Edition. New York: Irvington Publishers. 1976. 500 pages, S 15.95, hardcover. Journal of personality assessment, 42(2), 195-196. https://doi.org/10.1207/s15327752jpa4202_21

Kuipers, K. J., & Hysom, S. J. (2014). Common problems and solutions in experiments. In M. Webster, Jr. & J. Sell (Eds.), *Laboratory experiments in the social sciences* (pp. 145–177). Elsevier Academic Press. https://doi.org/10.1016/B978-0-12-404681-8.00007-8

Lane, S. D., & Critchfield, T. S. (1996). Verbal self-reports of emergent relations in a stimulus equivalence procedure. *Journal of the Experimental Analysis of Behavior*, *65*, 355–374. https://doi.org/10.1901/jeab.1996.65-355

McDonald, M. & Mouncey, P. (2009). Marketing accountability: How to measure marketing effectiveness. London: Kogan Page Ltd.

McIlvane, W. J., & Dube, W. V. (1992). Stimulus control shaping and stimulus control topographies. *The Behavior analyst*, *15*(1), 89–94. https://doi.org/10.1007/BF03392591

Munawaroh, M. (2015, 12/28). The Impact of Logo Design Towards Customer's Brand Image Perception: A Research of Logo Shapes And Colors in The Hotel Industry. *Journal of Business on Hospitality and Tourism, 1*, 13. https://doi.org/10.22334/jbhost.v1i1.21

Rafiq, M. R., Hussain, R. I., & Hussain, S. (2020). THE IMPACT OF LOGO SHAPES REDESIGN ON BRAND LOYALTY AND REPURCHASE INTENTIONS THROUGH BRAND ATTITUDE. *International review of management and marketing, 10*(5), 117-126. https://doi.org/10.32479/irmm.10308

Sidman, M. (2009). Equivalence relations and behavior: an introductory tutorial. *Anal Verbal Behav, 25*(1), 5-17. https://doi.org/10.1007/BF03393066

Smeets, P. M., & Barnes-Holmes, D. (2003). Children's emergent preferences for soft drinks: Stimulus-equivalence and transfer [Consumer Attitudes & Behavior 3920]. *Journal of Economic Psychology, 24*(5), 603-618. https://doi.org/http://dx.doi.org/10.1016/S0167-4870%2803%2900004-7

Vie, A., & Arntzen, E. (2017). Talk-aloud protocols during conditional discrimination training and equivalence class formation. *The Analysis of Verbal Behavior, 33*(1), 80–97. https://doi.org/10.1007/s40616-017-0081-y

Watt, A., Keenan, M., Barnes, D., & Cairns, E. (1991). Social Categorization and Stimulus Equivalence. *The Psychological Record*, 41(1), 33-50. https://doi.org/10.1007/BF03395092

Table 1

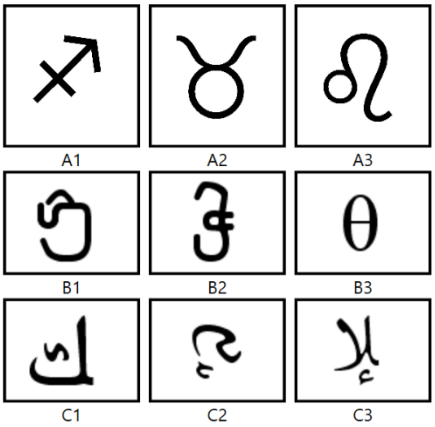
Shows the Results for the Participants who met the Mastery Criteria in the Experiment

Participant#	Trials phase 2	Trials phase 3	Pretest	Posttest	Posttest2	Posttest3
18362	150	75	B1	B1	B1	B1
18363	360	105	B3	B3	B3	B3
18364	270	75	B3	B1	B1	B2
18365	240	75	B2	B1	B1	B1
18366	450	60	B3	B1	B1	B1
18367	210	75	B3	B1	B1	B1
18368	210	75	B3	B2	B2	B2
18369	210	75	B2	B3	B1	B1
18370	240	75	B3	B3	B2	B3
18371	270	75	B3	B1	B3	B3
18372	450	90	B1	B1	B2	B3
18373	420	60	B3	B2	B1	B1
18374	150	90	B1	B3	B3	B1

Note. Participant# shows the number of each participant. Trials in phase 2 shows the number of responses produced in the conditional discrimination training. Trials phase 3 shows the number of trials in the class expansion training. Pretest and posttest show which stimulus had the can which was selected. Posttest 2 shows the stimulus which was on the selected car and posttest 3 shows the stimulus on the mobile phone selected by the participant.

Figure 1

Stimuli used in the Phase 1



Note. Stimuli used in the first phase of the experiment to form three equivalence classes with three class members each.

Figure 2

Stimuli used in the Class Expansion Phase

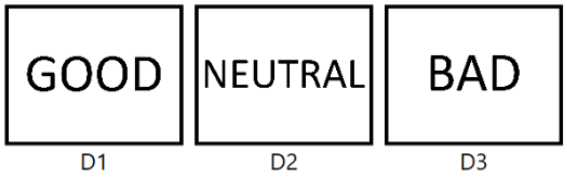


Figure 3

Beverage Cans used in the Preference Test.

Note. The labels show the B stimuli.

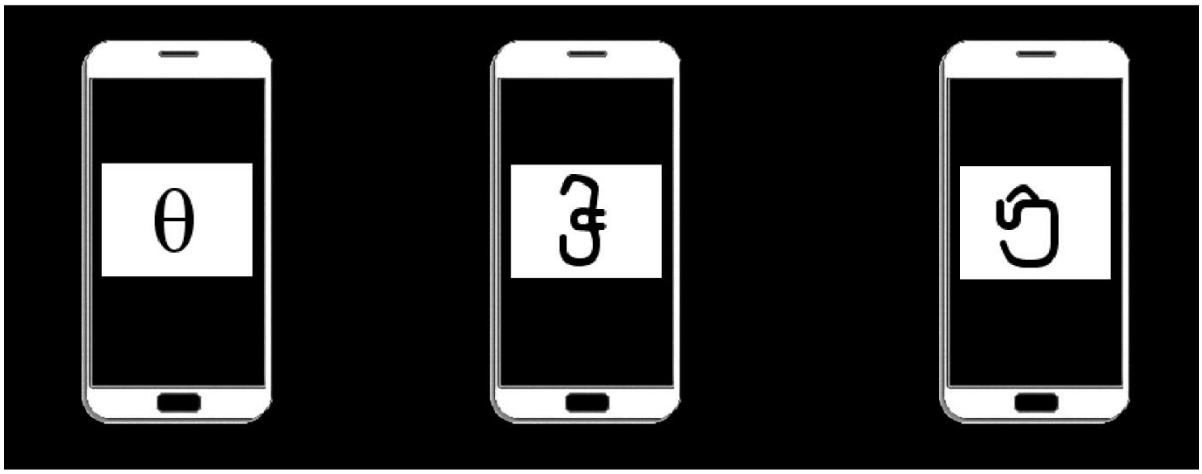
Figure 4a

Cars used in the Preference Test.

Note. The labels show the B stimuli.

Figure 4b

Mobiles used in the Preference Test.



Note. The labels show the B stimuli.

Figure 5

Diagram Presenting the Stages of the Experiment.

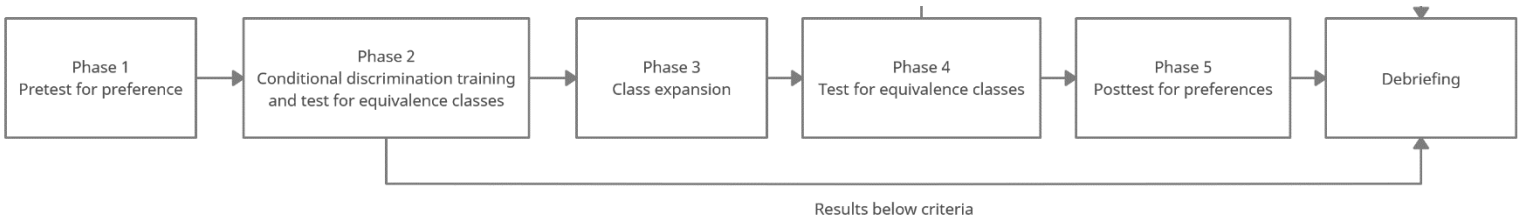


Figure 6

Results of the Preference Test for cans in Pretest and Posttest.

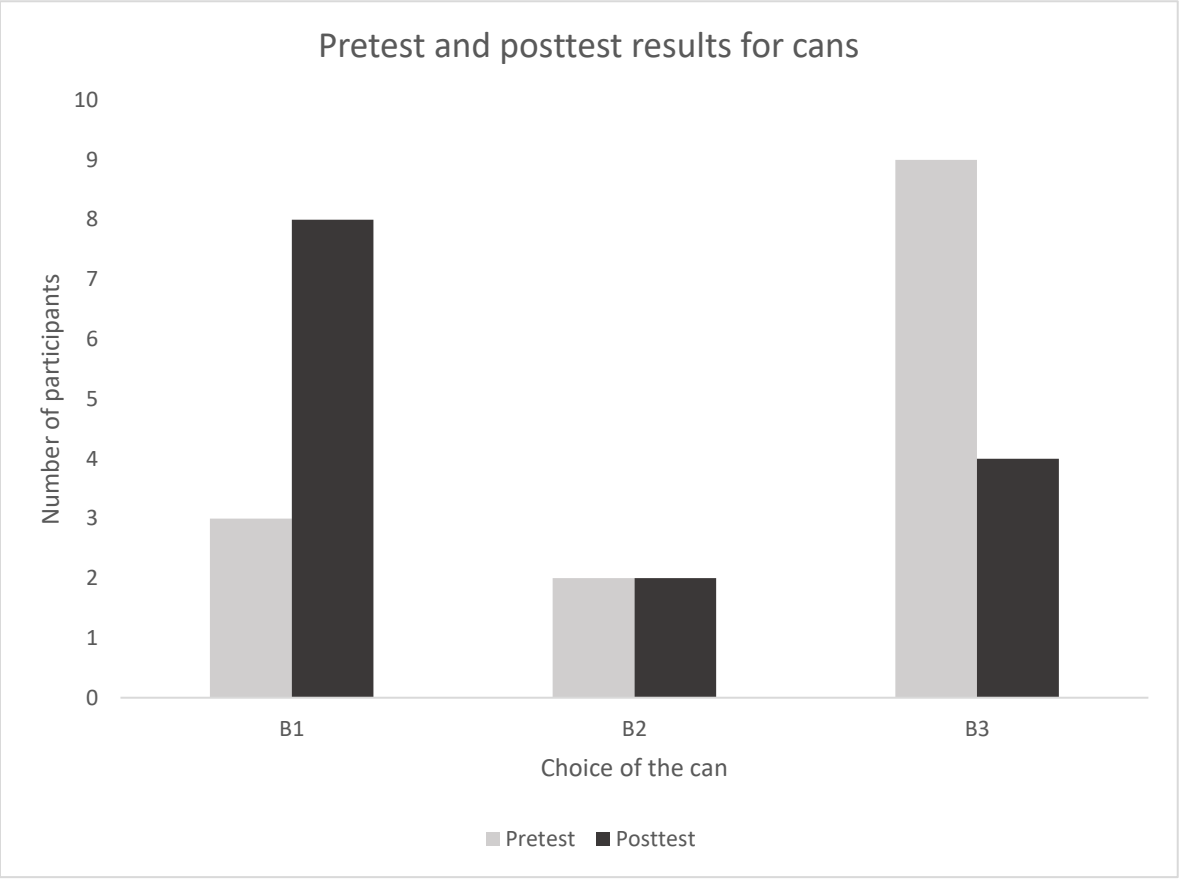
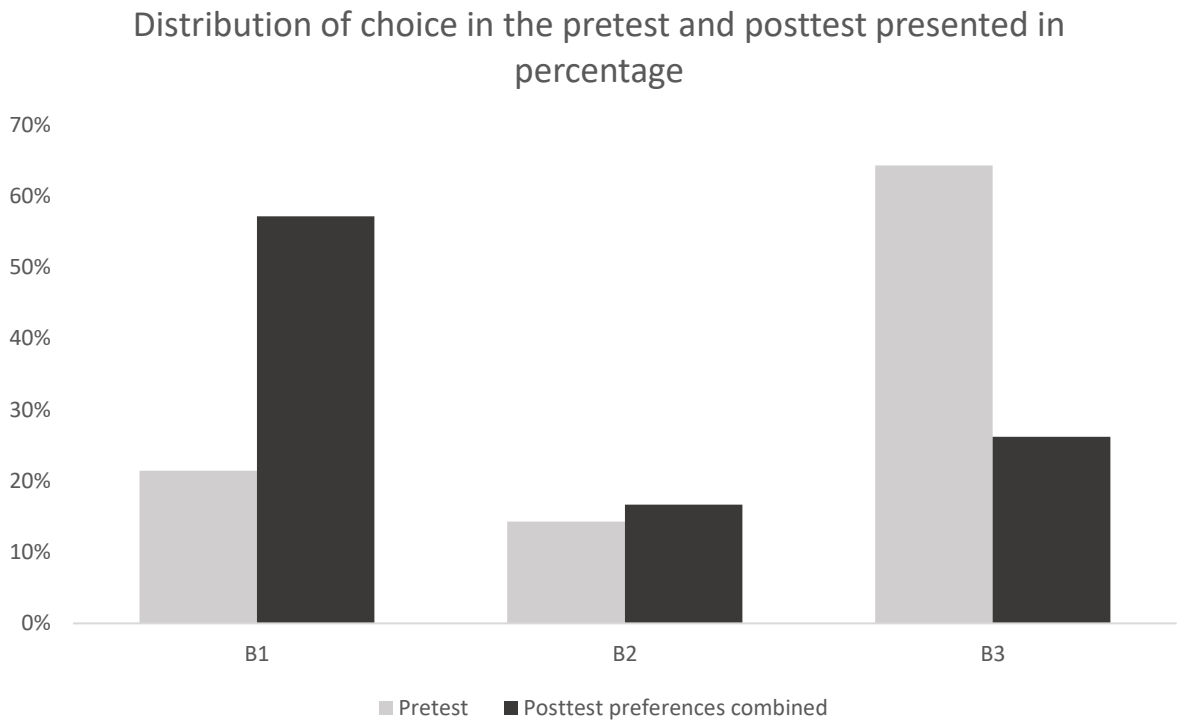


Figure 7

The distribution of Choices as a Percentage of the total Number of Choices



Note. The pretest includes only the choices for cans. The posttest preferences include the choices for cans, cars, and mobile phones.

Ethical considerations

For this experiment the approval of the Norwegian Data Protection Authority (NSD) was not required. The student consulted with the supervisor of the thesis and checked replies of the NSD for applications for studies which gathered the same data in the same way. The answer of the NSD was that there is no need for applying since the data gathered by the computer program during the experiment was assigned to a number not traceable to the participants. The names of the participants where not stored. Nowhere the name of the participant was recorded and therefore not traceable to the participant. There were no so-called vulnerable participants in the group (minors, mentally challenged, social clients, the disabled, residents of old age or nursing homes and the demented etc.) Participants in order to partake had to approve the consent form where they were informed of:

Background of the study – it being master thesis project at the Oslo Metropolitan University.

That they will be able to see their own results after ended session, get information on the stimulus equivalence and the purpose of the current study. Followed by debriefing where all their questions will be addressed. The participants were beforehand informed and reminded in the consent form that the experiment is done online, through ZOOM meeting application with the approximal duration of two hours. During the experiment, both the experimenter and the participant will switch of their camera and mute their devices. The consent form stated that the experiment is conducted to collect data for scientific purposes only and does not involve clinical treatment or training and that under no circumstance the personal information about participants will not be provided to anyone and that they cannot be identified with the results after the ended session. Participants were also informed of their right to withdraw at any moment during the

experiment without the need of providing the reason. Participants were also encouraged in case of any doubt or further questions to contact the supervisor of the project. Only after the participants clicked (no physical signature was needed or collected) that they agree on the described above rules and rights, they could proceed to the experiment.

When it comes to the feedback from the participants it was mentioned by many of them that the study was lengthy and that the task after a while became rather simple and tiresome once they have understood the pattern. It was considered to shorten the sessions but because of the procedure it was unable to do so. The experimenter has tried in the debriefing to acknowledge their effort and point to the parts where their performance was great to enhance the general feeling of achievement, mastering and learning something new. Participants were partaking in the experiment through their own computer. They were asked to find a quiet place without disturbance for the duration of the experiment. Hence their comfort during the experiment was arguably higher in their own house than if they had to meet in person in the laboratory or a classroom. All the participants were invited to the experiment with individual zoom meeting link protected by a password. The risk analysis (ROS) is attached to the thesis.

	Vurder kun hendelser og risikoelement som er reelle og relevante for dette prosjektet. Bruk nedtrekksmeny (drop down). Du kan velge samme kategori på flere linjer.	Benytt nedtrekksmeny (drop down).	**Hva kan skje?**	**Hva er den uønskede hendelsen? Hvilke tap oppstår? Hvilken betydning for prosjektet?**		**Sannsynlighet og konsekvens på en skala fra 1 til 4.** **1 = Lav/liten, 4 = Svært høy.** Risiko generes automatisk som resultat av sannsynlighet og konsekvens.			**Beskriv forslag til nye tiltak.** De kan deles opp i organisatoriske, menneskelige og teknologiske sikringstiltak.
EKSEMPI	***Datainnsamling***	***Lydopptak***		*Mister diktafon på vei fra informant til kontoret.*		*2*	*3*	*5*	*Kryptere diktafon. Vurdere å bruke mobilapp; Gjøre nytt intervju*
1	**Datainnsamling**	**Eksperimentelle/Fysiologiske data**	**Eksperimentator påvirker resultater**	Eksperimentator sier ting på forskjelige måter til deltagere og det påvirker valgsituasjoner/reslultater	Eksperimentator har en mal av ting som skal sies og spørsmål som skal leses	2	1	3	1. Man kan inkluldere en observator som skal observere at spørsmål leses neutralt. 2. Spørsmål kan presenteres på skjermen til deltagere i stedet
2	**Datainnsamling**	**Eksperimentelle/Fysiologiske data**	**Data kan kobles til individer**	Innsamlet data kan kobles til deltagere og derfor blir de ikke anonime	Alle deltagere ble tildelt et nummer som ikke er sporbar til navnet	1	1	2	
3	**Datainnsamling**	**Nettskjema**	**Noen hakker seg inn på zoommøte under eksperimentet**	Ubehag for deltager og eksperimentator, hendelse kan føre til at data kan ikke brukes	Alle deltagere ble invitert til zoom som var beskyttet med passordet kjent bare til deltager og eksperimentator	1	1	2	