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Equivalência de estímulos e transferência de função: avaliando os efeitos dos
controles por seleção e por rejeição

(versão corrigida)

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Tese apresentada ao Instituto de Psicologia da
Universidade de São Paulo como parte dos
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Orientador: Prof. Dr. Gerson Yukio Tomanari

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TRABALHO, POR QUALQUER MEIO CONVENCIONAL OU ELETRÔNICO,
PARA FINS DE ESTUDO E PESQUISA, DESDE QUE CITADA A FONTE.

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RESUMO

Perez, W. F. (2012). *Equivalência de estímulos e transferência de função: avaliando os efeitos dos controles por seleção e por rejeição*. Tese de doutorado, Instituto de Psicologia, Universidade de São Paulo, São Paulo.

Em uma tarefa de emparelhamento com o modelo envolvendo duas escolhas, o participante pode aprender tanto a selecionar o estímulo correto (controle por seleção) quanto a rejeitar o estímulo incorreto (controle por rejeição). O presente trabalho investigou o efeito dos controles por seleção e por rejeição sobre a formação de classes de estímulos equivalentes e sobre a transferência de função discriminativa. O Capítulo 1 apresenta uma revisão metodológica que sistematizou os procedimentos utilizados para inferir a ocorrência desses controles, bem como os procedimentos utilizados para manipulá-los experimentalmente. O Capítulo 2 apresenta um experimento que investigou o efeito da manipulação da observação dos estímulos de comparação sobre o estabelecimento dos controles por seleção e por rejeição. Participantes adultos foram submetidos a um treino de discriminações condicionais por meio do procedimento de emparelhamento com o modelo com observação requerida (MTS-OR). Os resultados sugerem que a ocorrência do controle por seleção foi mais provável para os participantes que foram exigidos observar o S+ ao longo de todas as tentativas de treino; o controle por rejeição só ocorreu para os participantes que foram exigidos observar o S-. Nesse último caso, impedir os participantes de observar o S+ favoreceu o estabelecimento do controle pelo S-. Por fim, o Capítulo 3 apresenta um conjunto de experimentos que avaliou o efeito dos controles por seleção e por rejeição sobre os testes de formação de classe de equivalência e sobre a transferência de função discriminativa. O procedimento de MTS-OR, aliado ao uso de diferentes proporções de S+/S-, permitiu a manipulação experimental dos controles investigados. A transferência de função foi avaliada por meio de uma tarefa discriminativa simples sucessiva envolvendo respostas ao teclado. Os resultados sugerem que os testes de reflexividade, bem como os de transitividade e de equivalência envolvendo um nodo, foram afetados diferencialmente por esses controles. Os resultados dos testes de transferência de função sugerem a formação de diferentes classes a depender do controle estabelecido, por seleção ou por rejeição.

Palavras-chave: equivalência de estímulos; transferência de função; emparelhamento com o modelo com observação requerida (MTS-OR); adultos.

ABSTRACT

Perez, W. F. (2012). Stimulus equivalence and transfer of function: Evaluating the effects of select and reject controls. Ph.D. dissertation, Instituto de Psicologia, Universidade de São Paulo, São Paulo.

In a two-choice matching-to-sample task, the participant might learn either to select the correct stimulus (select control) or to reject the incorrect one (reject control). The present dissertation investigated the effects of select and reject controls upon equivalence-class formation and transfer of discriminative function. Chapter 1 presents a methodological review that analyzed procedures used to infer the occurrence of such controls and also procedures used to experimentally manipulate them. Chapter 2 presents an experiment that evaluated the effects of manipulating observing responses towards comparison stimuli upon the establishment of select or reject controls. Adults participated and were exposed to a conditional discrimination training in a matching-to-sample task with observing requirements (MTS-OR). Results suggest that select control was more likely to occur for participants that were required to observe the S+ in every training trial; reject control occurred only for participants that were required to observe the S- in every training trial. In this last case, preventing participants from observing the S+ also increased the chances of control by the S-. Finally, Chapter 3 presents experiments that evaluated the effects of select or reject controls upon equivalence-class-formation tests and transfer of discriminative function. The MTS-OR procedure, allied with different proportions of S+/S-, allowed manipulating the controls that were investigated. The transfer of function was evaluated by means of a simple successive discrimination task involving key-pressing responses on the keyboard. The results suggest that the reflexivity tests, and also the one-node transitivity and equivalence tests, were differentially affected by such controls. Transfer of function test results suggest the formation of different classes depending on the control that was established, select or reject.

Keywords: stimulus equivalence; transfer of function, matching-to-sample with observing requirements (MTS-OR); adults

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APRESENTAÇÃO

Quando exposto a uma situação de duas escolhas, o organismo pode atender à exigência da contingência em vigor tanto ao selecionar o estímulo programado como correto (S+) quanto ao rejeitar aquele programado como incorreto (S-). O estudo dos controles por seleção ou por rejeição é recorrente desde as primeiras investigações sobre discriminação condicional e, mesmo depois de décadas, ainda traz desafios aos pesquisadores no que concerne ao desenvolvimento de procedimentos de mensuração e de manipulação experimental. A principal dificuldade no estudo dos controles por seleção e por rejeição se deve ao fato de que esses não podem ser inicialmente distinguidos a partir do registro das respostas de escolha do participante durante a tarefa de emparelhamento com o modelo. Em ambos os casos, o estímulo correto é sempre escolhido. No entanto, no primeiro caso, a escolha é controlada pelo estímulo programado como S+; no segundo, pelo estímulo programado como S-.

Pesquisas sugerem que os controles por seleção e por rejeição têm relação estreita com diversos comportamentos complexos. Tais controles têm sido tema de estudos sobre aprendizado relacional por igualdade e por diferença, aprendizagem por exclusão, responder condicional generalizado e também equivalência de estímulos. Nesse último caso, o estabelecimento do controle por seleção ou por rejeição parece afetar diferencialmente o aprendizado simbólico.

A tese de doutorado aqui apresentada teve como tema de investigação os controles por seleção e por rejeição em tarefas de emparelhamento com o modelo e seus efeitos sobre a formação de classes de equivalência e sobre a transferência de função. Tendo em vista a dificuldade encontrada no estudo desses controles, a primeira estratégia adotada foi a realização de uma extensa revisão de literatura, apresentada no Capítulo 1. A análise crítica dos procedimentos utilizados em diferentes investigações e dos resultados de décadas de pesquisas aponta para uma

escassez de estudos que manipularam experimentalmente o estabelecimento dos controles por seleção e por rejeição. O Capítulo 2 avança no ponto sugerido pela revisão metodológica e apresenta um experimento que teve por objetivo avaliar os efeitos da manipulação da observação das comparações sobre o estabelecimento desses controles. Por fim, tendo desenvolvido um procedimento que permite manipular experimentalmente os controles por seleção e por rejeição, uma série de três experimentos avaliou os efeitos de tais controles sobre a formação de classes de equivalência e sobre a transferência de função. Tais experimentos são apresentados no Capí

Os três capítulos apresentados a seguir são, em realidade, artigos independentes que giram em torno de um mesmo eixo temático. Tendo optado por estruturar o trabalho desse modo, peço, de antemão, desculpas ao leitor pelas eventuais repetições que ocorrerão de um capítulo para outro. Elas foram inevitáveis. Em contrapartida, estruturar a tese desse modo me ajudou a produzir com foco em publicar, o mais prontamente possível, o produto de três anos de trabalho, que contou com financiamento, público, da FAPEP, da CAPES/Fulbright e também do Instituto Nacional de Ciência e Tecnologia sobre Comportamento, Cognição e Ensino (INCT-ECCE). Como resultado dessa estratégia, os dois primeiros capítulos já foram encaminhados para periódicos internacionais. O terceiro, por sua vez, aguarda as sugestões da banca de defesa.

CAPÍTULO 1

Controles por Seleção e por Rejeição em Tarefas de Emparelhamento com o Modelo:
uma Revisão Metodológica²

² Parte desse trabalho foi apresentado em 2010 na 36th Annual Convention of the Association for Behavior Analysis International, realizada em San Antonio, Texas, EUA.

Resumo

Os controles por seleção e por rejeição e seus efeitos sobre o comportamento têm sido estudados há décadas. Frequentemente, dificuldades metodológicas são encontradas no que diz respeito aos procedimentos empregados para inferir a ocorrência desses controles ou para estabelecê-los. O presente artigo traz uma revisão dos procedimentos utilizados nos estudos dos controles por seleção e por rejeição. Inicialmente, os testes de equivalência, os testes com estímulos novos, os testes com máscara, o rastreamento do movimento dos olhos e o procedimento de emparelhamento ao modelo com observação requerida (MTS-OR) são descritos e avaliados como alternativas de mensuração desses controles. Em seguida, são analisados procedimentos que permitem manipular o estabelecimento dos controles por seleção ou por rejeição durante o treino. Entre eles estão o uso de diferentes proporções de S+/S-, os procedimentos de dica atrasada e de dica do S+, a realização do treino com máscara e variações do procedimento MTS-OR. Alguns parâmetros que podem influenciar o estabelecimento dos controles por seleção e por rejeição, tais como o número de comparações apresentado e a topografia de resposta, também são analisados e discutidos. A presente revisão organiza e analisa criticamente os procedimentos utilizados para o estudo dos controles por seleção e por rejeição. Sugere-se a necessidade de desenvolver novos procedimentos para inferir a ocorrência e manipular o estabelecimento desses controles.

Palavras chave: controle por seleção, controle por rejeição, modelo/S+, modelo/S-, emparelhamento com o modelo, equivalência de estímulos.

Abstract

Select and reject controls and their effects over behavior have been studied for decades. Methodological difficulties related to the procedures used to infer the occurrence of these controls or manipulate its establishment are not rare. The present paper review the procedures used to study select and reject controls. Initially, equivalence tests, testing with novel stimuli, tests with blank-comparison, tracking participant's eye movements and the matching-to-sample task with observing requirements (MTS-OR) are described and evaluated as alternatives to measure the occurrence of these controls. After that, the procedures that are used to manipulate the establishment of select or reject controls during training are presented and evaluated. Among them, the use of different proportions of S+/S-, the delayed cue procedure and the delayed S+ onset, training with blank-comparison and variations of the MTS-OR procedure. Some parameters that might influence the establishment of select and reject controls, such as the number of comparisons and the topography of the response are also analyzed and discussed. The present methodological review organizes and critically analyzes the procedures used so far to study select and reject controls. The necessity of developing new procedures to infer and manipulate the establishment of these controls is suggested.

Keywords: select control, reject control, sample/S+, sample/S-, matching to sample, equivalence relations.

Controles por Seleção e por Rejeição em Tarefas de Emparelhamento com o Modelo: uma Revisão Metodológica

Ao emitirem respostas, os organismos modificam seu ambiente. Tais modificações (consequências) alteram a frequência de ocorrência futura de respostas da mesma classe. Respostas seguidas de consequências reforçadoras têm a sua frequência de ocorrência aumentada. Respostas seguidas de consequências punitivas ou extinção têm sua frequência de ocorrência reduzida. Os estímulos que antecedem a ocasião em que uma dada resposta é seguida de suas consequências, por sua vez, também adquirem controle sobre o responder, ocasionando ou não a sua emissão a depender da função exercida pela consequência que segue a resposta (Skinner, 1953, 1957).

Quando o responder ocorre na presença de um dado estímulo e não de outro, ele está sob controle discriminativo. Por exemplo: em uma tarefa no computador, dois estímulos visuais são apresentados na tela, B1 e B2. O participante é instruído a escolher um deles utilizando o *mouse*. Escolher B1 é seguido do acúmulo de pontos em um contador; escolher B2 não. Caso o participante escolha o estímulo B1 e não B2, consistentemente, diz-se que B1 adquiriu função discriminativa no controle da resposta emitida. O estímulo na presença do qual respostas de escolha são seguidas de consequências reforçadoras (no exemplo, pontos), no caso B1, é chamado de S^D (estímulo discriminativo) ou S^+ . Alternativamente, o estímulo na presença do qual respostas não são seguidas de consequências reforçadoras, no caso, B2, é chamado de S^Δ ou S^- . Esse é um exemplo de um procedimento de discriminação simples e do controle discriminativo que ele estabelece (Skinner, 1953).

O responder discriminado pode, ainda, ocorrer sob controle de outro estímulo, de tal forma que B1 e B2 podem ou não ocasionar a emissão da resposta a depender da presença de um estímulo condicional (A1 ou A2). Nesse caso, escolher B1, e não B2, só é seguido de consequências reforçadoras na presença (é condicional à presença)

de A1, enquanto que escolher B2, e não B1, só é seguido de consequências reforçadoras na presença de A2. Tem-se aqui um exemplo de discriminação condicional (Cumming & Berryman, 1965).

O procedimento de *matching to sample* (MTS) tem sido tradicionalmente utilizado no estudo de discriminações condicionais (Sidman, 1994). No procedimento de MTS, a cada tentativa, um estímulo modelo é apresentado simultânea ou sequencialmente a outros dois ou mais estímulos, denominados estímulos de comparação. A tarefa do organismo exposto ao procedimento de MTS é escolher um dos comparações em acordo com o estímulo modelo. Em diferentes tentativas, os comparações têm sua função discriminativa (S^D ou S^Δ) alterada (Cumming & Berryman, 1965) em função do modelo apresentado, configurando-se uma situação de discriminação condicional. As discriminações condicionais treinadas são usualmente representadas pela junção de duas letras maiúsculas que correspondem aos conjuntos de estímulos envolvidos no treino. Considerando o exemplo apresentado anteriormente, AB corresponderia ao treino das discriminações condicionais entre os estímulos do conjunto A e os estímulos do conjunto B. A primeira letra do par representa os estímulos modelo, enquanto a segunda representa os estímulos comparação. Nesse caso, os estímulos do conjunto A seriam sucessivamente apresentados como modelo e os estímulos do conjunto B seriam simultaneamente apresentados como comparações. Os estímulos de cada conjunto, por sua vez, são representados pela letra que corresponde ao conjunto seguida de um dígito (A1, A2, ..., An, como estímulos do conjunto A; B1, B2, ..., Bn, como estímulos do conjunto B). A relação entre os estímulos é representada pela junção dos rótulos dos estímulos, sendo que o rótulo à esquerda é sempre o modelo em relação ao da direita, que é apresentado como comparação (por exemplo, A1B1). Por fim, na notação das tentativas de MTS, o modelo é o primeiro estímulo representado da esquerda para a direita. Depois de um traço, são representados os comparações, sendo que, aquele cuja escolha é seguida de reforço (S+), ou que é

designado como a escolha “correta” diante daquele modelo, aparece sempre sublinhado (por exemplo, A1-B1B2 e A2-B1B2, no caso do treino AB).

No exemplo adiante, considerar-se-á um treino de MTS entre três conjuntos (A, B e C), formados por dois estímulos cada (A1 e A2; B1 e B2; C1 e C2), em uma sequência de tentativas na qual um estímulo modelo é apresentado junto a dois estímulos comparação. Considerando um treino das relações entre os conjuntos AB (A1-B1B2 e A2-B1B2) e BC (B1-C1C2 e B2-C1C2), tem-se como resultado as seguintes relações entre os estímulos de cada conjunto: A1B1 e A2B2 para o treino AB; B1C1 e B2C2, para o treino BC. Tomando como exemplo o treino AB, para que as relações condicionais A1B1 e A2B2 se estabeleçam, um dado estímulo deve ser apresentado como modelo (A1 ou A2), seguido, usualmente depois de uma resposta de observação, da apresentação de dois estímulos comparação (B1 e B2), dos quais somente um pode ser escolhido. Na presença de A1, escolher B1 (S+) é seguido de um reforçador; escolher B2 (S-), não. Na presença de A2, escolher B2 (S+) é seguido de um reforçador; escolher B1 (S-), não. Já no caso do treino BC, para o ensino das relações B1C1 e B2C2, na presença de B1, escolher C1 (S+) é seguido de um reforçador; escolher C2 (S-), não. Na presença de B2, escolher C2 (S+) é seguido de um reforçador; escolher C1 (S-), não.

Relações condicionais, como as descritas acima, podem gerar relações de equivalência entre estímulos. Dado um treino de discriminação condicional AB e BC entre três conjuntos de estímulos (A, B e C), convencionalmente, diz-se que os estímulos que compõem cada conjunto formam uma classe de estímulos equivalentes caso eles sejam substituíveis entre si, o que implicaria apresentar, um em relação ao outro, as seguintes propriedades: reflexividade, simetria e transitividade (Sidman & Tailby, 1982). A verificação dessas propriedades, durante testes em que novas combinações modelo-comparações são apresentadas, ocorre por meio da emergência de novas relações condicionais que não foram ensinadas diretamente no treino

(AB/BC): as relações AA, BB e CC, chamadas de reflexividade; BA e CB, chamadas de simetria; e AC, chamadas de transitividade. Existe ainda o teste de simetria da transitividade (ou de equivalência), CA, que envolveria logicamente todas as outras relações e demonstraria, resumidamente, a formação de classes de estímulos equivalentes (Sidman, 1994; Sidman & Tailby, 1982).

Para que a reflexividade seja demonstrada, o participante deve responder a cada estímulo com relação a ele mesmo em acordo com o tipo de relação condicional treinada na presença do estímulos dos outros conjuntos. Se, durante o treino AB, os participantes aprenderam a escolher o estímulo comparação B1 diante do modelo A1 e B2 diante de A2, por exemplo, a reflexividade (AA) seria demonstrada se, tendo A1 e A2 como modelos e comparações, A1 fosse escolhido diante de A1 e A2 diante de A2. O mesmo se aplica aos estímulos dos demais conjuntos (escolher B1 diante de B1; C1 diante de C1 etc). Para que a simetria seja demonstrada, estímulos modelo e comparação devem ter suas funções permutadas de tal forma que B1 e B2, apresentados como comparação durante o treino AB, passem a ser apresentados como modelos seguidos de A1 e A2 como comparações, por exemplo. Caso o participante escolha A1 diante de B1 e A2 diante de B2, a emergência da relação simétrica BA será demonstrada. O mesmo se dá para a relação CB. A transitividade (AC), por sua vez, é verificada quando o participante responde relacionando modelos e comparações que nunca foram apresentados em um mesmo treino, mas que, durante essa fase, foram relacionados a outros estímulos em comum (tanto A quando C, durante o treino, foram relacionados com B). Depois de aprender as relações entre os estímulos dos conjuntos AB e BC, a transitividade será demonstrada caso o participante escolha o estímulo comparação C1 diante do modelo A1 e C2 diante de A2. No teste de equivalência (CA) a formação de classes é atestada caso o participante escolha A1 diante de C1 e A2 diante de C2 (de Rose, 1996; Sidman, 1994).

Controle por Seleção e por Rejeição

As ocorrências de treinos de discriminação condicional bem-sucedidos seguidos de resultados negativos nos testes de formação de classes de estímulos equivalentes (reflexividade, simetria, transitividade e equivalência) indicam a possibilidade de que outras variáveis, além do cumprimento do treino, estejam envolvidas no estabelecimento de relações de equivalência (cf. de Rose, 1996; McIlvane, Serna, Dube, & Stromer, 2000). Tais variáveis, por sua vez, podem ter relação com controles estabelecidos durante o próprio treino, mas que não foram planejados pelo experimentador (McIlvane et al., 2000). O controle por rejeição, descrito adiante, é uma das possibilidades de controle espúrio que pode vir a ser estabelecido. Como mostra a Figura 1, em um treino de MTS como o descrito anteriormente (AB na tentativa A1-B1B2, por exemplo), o responder discriminado pode ser fruto de diferentes controles (e.g., Carrigan & Sidman, 1992; Johnson & Sidman, 1993). A resposta de escolher o estímulo que é seguido de reforço (B1) pode ser ocasionada tanto pelo estímulo modelo (A1) e pelo comparação programado como S+ (B1), quanto pelo estímulo modelo (A1) e pelo comparação programado como S- (B2). No primeiro caso, denominado *controle por seleção* (ou *seleção*), os estímulos modelo (A1) e comparação programado como S+ (B1) controlam a escolha do comparação que é seguido de reforço (nesse caso, o próprio comparação do par de estímulos que controla o responder é o S+, B1). No segundo caso, denominado *controle por rejeição*³ (ou *rejeição*), o estímulo modelo (A1) e o comparação programado como S- (B2) controlam a escolha do outro comparação disponível, que é seguido de reforço. Cabe

³ As relações de controle por seleção e por rejeição também são denominadas em outros estudos da área como, por exemplo, *Type S control* e *Type R control* (Carrigan & Sidman, 1992), *control by sample-S+ relation* e *sample-S- relation* (Dixon & Dixon, 1978), *select-control relation* e *reject-control relation* (Goulart, Mendonça, Barros, Galvão, & McIlvane, 2005), *positive* e *negative stimulus relations* (McIlvane, Withstandley, & Stoddard, 1984), ou *S^D rule* e *S^A rule* (Cumming & Berryman, 1965), respectivamente.

ressaltar que, na rejeição, embora o comparação programado como S+ seja escolhido, tal estímulo não participa da relação condicional modelo-comparação que controla o responder (nesse caso, modelo/S-). Por essa razão, segundo estudos apontam, quando o responder ocorre por rejeição, o estímulo programado como S+ pode ser trocado por outro estímulo (e.g., Stromer & Osbourne, 1982; Stromer & Stromer, 1989) ou coberto (e.g., Goulart, Mendonça, Barros, Galvão, & McIlvane, 2005, McIlvane, Withstandley, & Stoddard 1984) sem alterar o desempenho do participante na tarefa. Assim, o par de estímulos modelo/S- controla a escolha do outro comparação disponível, não importando as propriedades formais específicas desse último. Estudos que rastrearam o movimento dos olhos (Magnusson, 2002; Perez, 2008) apontam que, na rejeição, o participante pode responder tendo observado apenas o estímulo modelo e o comparação programado como S-.

Figura 1. Controles por seleção (à esquerda) e por rejeição (à direita) em uma tentativa de MTS na qual um estímulo modelo é apresentado simultaneamente a dois estímulos de comparação. O desenho da mão indica o comparação escolhido.

Tento em vista que, em uma mesma tentativa de MTS, diferentes pares de estímulos (modelo/S+ ou modelo/S-) podem controlar a mesma resposta de escolha de um dado comparação, o controle por seleção e o controle por rejeição podem ser

vistos como diferentes *topografias de controle de estímulo (TCE)* (Dube & McIlvane, 1996; Goulart et al., 2005; McIlvane, 1998; McIlvane & Dube, 1992; 2003; McIlvane et al., 2000; Serna, Lionello-DeNolf, Barros, Dube, & McIlvane, 2004). O termo topografia de controle de estímulo, por sua vez:

se refere às características físicas, relações estruturais e propriedades controladoras dos estímulos. Uma TCE é um paralelo conceitual de topografia de respostas: da mesma maneira que topografia de resposta distingue entre várias formas de resposta que produzem o mesmo resultado mensurado, TCE distingue *várias formas de relações de controle de estímulos que produzem a mesma medida de desempenho* (Serna et al., 2004, p. 255, *itálicos acrescentados*).

Seleção, Rejeição e suas Implicações para a Formação de Classes de Equivalência

Carrigan e Sidman (1992), em um estudo teórico, propuseram que os controles por seleção e por rejeição podem gerar diferentes resultados nos testes de equivalência. Como mostra a Tabela 1, de acordo com Carrigan e Sidman, resultados opostos seriam observados nos testes de equivalência (simetria da transitividade), transitividade e reflexividade a depender do controle (seleção ou rejeição) estabelecido durante o treino. Quando o controle estabelecido entre todos os estímulos da classe for por seleção, serão esperados resultados positivos nesses testes, ou seja, aproximadamente 100% de respostas em acordo com as classes programadas pelo experimentador. Por outro lado, se o controle por rejeição for estabelecido, serão esperados resultados negativos, ou seja, aproximadamente 0% de respostas em acordo com as classes programadas pelo experimentador. Os resultados do teste de simetria, por sua vez, seriam positivos, em ambos os casos,

independentemente do controle estabelecido (para uma descrição detalhada, ver Perez & Tomanari, 2008).

Tabela 1. Resultados esperados nos testes de equivalência a depender do controle estabelecido durante o treino: por seleção ou por rejeição.

	Transitividade	Simetria	Equivalência	Reflexividade
Seleção	✓	✓	✓	✓
Rejeição	-	✓	-	-

De modo a analisar os efeitos dos controles por seleção ou por rejeição na formação de classes de estímulos equivalentes, Carrigan e Sidman (1992), avaliaram teoricamente os resultados nos teste de reflexividade, simetria, transitividade e equivalência em função desses diferentes controles estabelecidos durante o treino. De acordo com esses autores, uma discriminação condicional é composta por: 1) um par de estímulos modelo/comparação que controla o responder (e.g., A1B1, A2B2...) e 2) um componente comportamental que define a forma como o primeiro estímulo do par se relaciona com o segundo (e.g. se A1, selecione B1; ou se A1, rejeite B2).

Visando apresentar a análise de Carrigan e Sidman (1992) com base na conceituação apresentada acima, considera-se o caso de um participante para o qual, durante todas as tentativas do treino, modelo e comparação programado como S+, por exemplo A1B1 e B1C1, controlaram a escolha do próprio S+ (i.e. A1 selecionar B1 e B1 selecionar C1). Tendo em vista os controles estabelecidos durante o treino, no teste de transitividade, quando a tentativa A1-C1C2 é apresentada, A1C1 controlarão

a escolha do próprio C1 (A1 seleção C1). No teste de equivalência, quando a tentativa C1-A1A2 for apresentada, C1A1 controlarão a escolha do próprio A1 (C1 seleção A1). No teste de reflexividade, na tentativa A1-A1A2, o par A1A1 controlará a escolha do próprio A1 (A1 seleção A1). Por fim, no teste de simetria, quando a tentativa B1-A1A2 for apresentada, B1A1 controlarão a escolha do próprio A1 (B1 seleção A1). Essa mesma análise pode ser realizada para as relações condicionais A2B2 e B2C2.

De acordo com Carrigan e Sidman (1992), os resultados (estímulos escolhidos) decorrentes de um treino no qual o controle por seleção é estabelecido para todas as relações condicionais, nos testes de formação de classes, são coerentes com as contingências programadas pelo experimentador. Por outro lado, resultados opostos nos testes de transitividade, equivalência e reflexividade serão observados caso o controle por rejeição tenha se estabelecido durante o treino. A seguir, considera-se o caso de um participante para o qual, durante o treino, modelo e comparação programado como S-, por exemplo A1B2 e B2C1, controlaram a escolha do outro estímulo disponível, aquele programado como S+ (e.g. A1 rejeitar B2, B2 rejeitar C1). Tendo em vista os controles estabelecidos durante o treino, no teste de transitividade, quando a tentativa A1-C1C2 for apresentada, A1C1 controlarão a escolha do outro estímulo disponível (A1 rejeitar C1), ou seja, C2 (programado como S-). No teste de equivalência, quando a tentativa C1-A1A2 for apresentada, C1A1 controlarão a escolha do outro estímulo disponível (C1 rejeitar A1), ou seja, A2 (programado como S-). No teste de reflexividade, na tentativa A1-A1A2, o par A1A1 controlará a escolha do outro estímulo disponível (A1 rejeitar A1), ou seja, A2 (programado como S-). No teste de simetria, por sua vez, os mesmos resultados seriam observados independentemente do controle estabelecido (por seleção ou por rejeição), ou seja, o mesmo comparação seria escolhido. Quando a tentativa B1-A1A2 for apresentada, B1A2 controlarão a escolha do outro estímulo disponível (B1 rejeitar A2), nesse caso,

A1 (programado como S+). Cabe ressaltar que essa mesma análise pode ser realizada para as relações condicionais A2B1 e B1C2.

A análise apresentada por Carrigan e Sidman (1992) foi confirmada empiricamente por estudos posteriores (Johnson & Sidman, 1993; Magnusson, 2002; Perez, 2008) e tem sido utilizada para explicar alguns casos em que a formação de classes não ocorre em acordo com as contingências programadas de treino das relações condicionais (Dube & McIlvane, 1996; Goulart et al., 2005; McIlvane & Dube, 2003; McIlvane et al., 2000). Considerando que diferentes resultados podem ser observados nos testes de equivalência a depender do controle estabelecido entre modelo e comparação durante o treino, os controles por seleção ou por rejeição tornam-se uma variável relevante no estudo da formação de classes de estímulos equivalentes. Segue, a partir daqui, uma revisão dos procedimentos utilizados no estudo desses controles.

Testes para Verificar a Ocorrência do Controle por Seleção ou por Rejeição

Tendo por base as respostas de escolha emitidas durante o treino das discriminações condicionais tal como tradicionalmente programado, nada pode ser dito acerca dos controles envolvidos na escolha do estímulo comparação (cf. Carrigan & Sidman, 1992; Johnson & Sidman, 1993; O'Donnell & Saunders, 1994; Serna, Wilkinson, & McIlvane, 1998; Wilkinson & McIlvane, 1997). Ao escolher o estímulo programado como S+, não é possível saber se tal resposta é controlada pelo modelo e pelo próprio comparação programado como S+ (seleção) ou pelo modelo e comparação programado como S- (rejeição). Na medida em que os controles por seleção ou rejeição não podem ser observados durante o treino, tal como usualmente realizado, esses devem ser inferidos a partir de outras manipulações experimentais (Wilkinson & McIlvane, 1997, p. 117). Para tanto, alguns estudos buscaram realizar, posteriormente a um desempenho estável nos treinos, testes que demonstrassem o(s) controle(s) em operação.

Testes de reflexividade, transitividade e equivalência. Como apontado por Carrigan e Sidman (1992), os próprios testes de equivalência podem ser indicadores da ocorrência dos controles por seleção ou por rejeição. Tais testes, no entanto, somente servem como medidas do estabelecimento desses controles em condições específicas, descritas a seguir, que não são necessariamente frequentes nos estudos de equivalência.

De acordo com Carrigan e Sidman (1992), resultados opostos nos testes de transitividade e equivalência (ver Tabela 1) são modulados pelo número de nodos que separam os conjuntos de estímulos apresentados nos testes. O termo “nodo” corresponde ao conjunto de estímulos com o qual dois ou mais conjuntos se relacionam. Por exemplo, em um treino AB/BC, existe apenas um conjunto de estímulos que é relacionado a dois outros conjuntos. O conjunto B, nesse caso, corresponde ao nodo das relações AB/BC. Supondo um treino AB/BC/CD, há, por sua vez, dois nodos: B, que se relaciona com os conjuntos A e C; e C, que se relaciona com os conjuntos B e D. Assim, a distância entre A e D é de dois nodos, B e C (Fields, Adams, Verhave, & Newman, 1990; Fields, Landon-Jimenez, Buffington, & Adams, 1995; Fields & Verhave, 1987). Segundo Carrigan e Sidman (1992), para que resultados diferenciais nos testes de equivalência sejam observados a depender do controle estabelecido, o número de nodos deve ser ímpar, como no treino AB/BC, descrito anteriormente.

Supondo um treino AB/BC/CD em que o controle por rejeição tenha sido estabelecido entre todos os pares de estímulos, embora não sejam esperados acertos nos testes AC/CA e BD/DB (separados por um único nodo, B no primeiro caso e C no segundo), nos testes AD e DA (em que os conjuntos A e D se encontram a dois nodos de distância, separados pelos conjuntos B e C) os resultados dos testes de transitividade e equivalência serão os mesmos observados no caso do controle por

seleção. Ou seja, o participante escolherá os estímulos de comparação em acordo com as contingências programadas pelo experimentador, não importando se o controle estabelecido foi por seleção ou rejeição.

Para avaliar os resultados nos testes de transitividade e equivalência realizados com conjuntos separados por um número par de nodos, supõe-se um participante que, durante o treino, tenha tido o responder controlado pelos pares de estímulos modelo e comparação programado como S- (rejeição), por exemplo A1B2, B2C1 e C1D2. Tendo em vista esses controles estabelecidos durante o treino, no teste de transitividade AD, quando a tentativa A1-D1D2 for apresentada, A1D2 controlarão a escolha do outro estímulo disponível (A1 rejeitar D2). Sendo assim, D1, programado como S+ para essa tentativa, será escolhido. Ou seja, o participante escolherá o estímulo em acordo com a classe planejada pelo experimentador, tal como ocorre quando o controle por seleção é estabelecido durante o treino. De maneira análoga, no teste de equivalência, quando a tentativa D2-A1A2 for apresentada, D2A1 controlarão a escolha do outro estímulo disponível (D2 rejeitar A1). Nesse caso, o estímulo programado como S+, A2.

Considerando que os testes de transitividade e equivalência podem não ser indicadores de seleção ou rejeição a depender do número de nodos presente no treino, o teste de reflexividade, no qual estímulos de um único conjunto são utilizados como modelo e comparação, pode ser vantajoso na medida em que independe do número de nodos (AA, BB, CC, ... XX). No entanto, embora o teste de reflexividade apresente a vantagem de não ter seu potencial preditor modulado por características da estrutura de treino (nodos), esse teste, assim como o de transitividade e equivalência, não serve como indicador preciso do controle por rejeição quando três ou mais estímulos de comparação são apresentados simultaneamente em uma mesma tentativa. Considerando que no treino de MTS só um dos comparações é programado como S+ e que todos os demais têm função de S-, o aumento do número

de comparações aumenta o número de S- na tentativa. Isso, por sua vez, dificulta a interpretação dos dados quanto à possibilidade de inferir qual das comparações programadas como S- controla, na presença de um dado modelo, a escolha da comparação programada como S+.

Por fim, outra limitação quanto ao uso dos testes de reflexividade, transitividade e equivalência reside no fato de que tais testes só funcionam como indicadores quando o controle por seleção ou rejeição é estabelecido de modo exclusivo entre todos os estímulos da classe. Isso é, quando somente um desses controles é estabelecido para todas as tentativas do treino (A1 seleção B1, B1 seleção C1, A2 seleção B2 e B2 seleção C2; ou A1 rejeição B2, B2 rejeição C1, A2 rejeição B1 e B1 rejeição C2). Quando alguns pares de estímulo se relacionam por seleção e outros por rejeição, os resultados se distanciam dos extremos das porcentagens de respostas apontadas pela análise de Carrigan e Sidman (1992), ou seja, resultados próximos a 100% na seleção e próximos a 0% na rejeição (e.g., de Rose, Hidalgo, & Vasconcellos, no prelo). Se diferentes controles são estabelecidos para diferentes tentativas de treino (e.g., A1 seleção B1, B1 rejeição C2, A2 seleção B2 e B2 rejeição C1) ou se ambos os controles são estabelecidos em uma mesma tentativa (e.g. A1 seleção B1 e A1 rejeição B2), os resultados são imprevisíveis teórica e experimentalmente (Carrigan & Sidman, 1992).

Testes com estímulos novos. Historicamente, o primeiro método utilizado para investigar a ocorrência dos controles por seleção ou por rejeição consiste em inserir, no treino de linha de base, tentativas de teste nas quais estímulos novos são apresentados no lugar do S+, para testar a ocorrência de controle por rejeição, ou do S-, para testar controle por seleção (Berryman, Cumming, Cohen, & Johnson, 1965; Carr, Wilkinson, Blackman, & McIlvane, 2000; Cumming & Berryman, 1961, 1965; de Rose et al., no prelo; Dixon & Dixon, 1978; Farthing & Opuda, 1974; Goulart et al.,

2005; Huziwara, 2010; Kato, de Rose, & Faleiros, 2008; Stromer & Osborne, 1982; Stromer & Stromer, 1989; Tomonaga, 1993; Urcuioli, 1977; Urcuioli & Nevin, 1975).

TREINO									
AB									
	A1			A2					
<u>B1</u>		B2		B1				<u>B2</u>	
BC									
	A1			A2					
<u>B1</u>		B2		B1				<u>B2</u>	
TESTE DE CONTROLE POR SELEÇÃO					TESTE DE CONTROLE POR REJEIÇÃO				
	A1			A2		A1		A2	
<u>B1</u>		N2	N1	<u>B2</u>	<u>N3</u>		B2	B1	<u>N4</u>
	B1			B2		B1		B2	
<u>C1</u>		N5	N6	<u>C2</u>	<u>N7</u>		C2	C1	<u>N8</u>

Figura 2. Dado um treino AB/BC, são apresentados testes com estímulos novos para a verificação de controle por seleção ou por rejeição. Cada tríade de estímulos corresponde a uma tentativa de *matching-to-sample* na qual o estímulo do vértice superior do triângulo é apresentado como modelo; os estímulos dos vértices esquerdo e direito da base do triângulo são apresentados como comparações, sendo que o comparação sublinhado corresponde ao estímulo escolhido. Tendo como exemplo a tentativa em que A1 é modelo e B1 e B2 são comparações: a) nos testes de controle por seleção, o S- (B2) é substituído por um estímulo novo (N2) e a escolha sistemática do S+ (B1, sublinhado) atesta controle por seleção do S+ (B1); b) nos testes de controle por rejeição, o S+ (B1) é substituído por um estímulo novo (N1) e a escolha sistemática desse estímulo atesta o controle por rejeição do S- (B2).

A Figura 2 apresenta um exemplo dessa técnica por meio de um treino AB com dois estímulos em cada conjunto (A1, A2, B1 e B2). Nos testes para identificação do

controle por seleção, os S- são substituídos por estímulos novos (N1 e N2); caso o participante se mantenha escolhendo B1 diante de A1 e B2 diante de A2, pode-se inferir o controle pela comparação programado como S+. Nos testes de identificação do controle por rejeição, por sua vez, os S+ são substituídos pelos estímulos novos (N3 e N4); caso o participante se mantenha escolhendo os estímulos novos (N3 diante de A1B2 e N4 diante de A2B1), pode-se inferir o controle pela comparação programado como S-.

Stromer e Osborne (1982 – Experimento I) fizeram uso dos testes com estímulos novos tal como descritos acima. Quatro participantes, residentes de um hospital psiquiátrico, foram submetidos a um treino AB com figuras abstratas. Depois de atingir o critério de aprendizagem estipulado para o treino e de passar por um teste de simetria (BA), os participantes foram submetidos a testes para verificar o estabelecimento do controle por seleção. Para todos os participantes, os estímulos novos, que substituíram o S-, praticamente não foram escolhidos. Posteriormente, foram realizados testes para verificar o estabelecimento do controle por rejeição. Todos os participantes escolheram sistematicamente os estímulos novos, que substituíram o S+. Em suma, os resultados obtidos nos testes sugerem que ambos os controles foram estabelecidos durante o treino.

Embora os testes com estímulos novos sejam extensamente utilizados, tanto com participantes humanos (e.g., Dixon & Dixon, 1978; Stromer & Osborne, 1982; Stromer & Stromer, 1989) quanto com animais (e.g., Cumming & Berryman, 1961, 1965; Urcuioli & Nevin, 1975), o efeito da novidade pode dificultar a interpretação dos dados. Animais apresentam a tendência de evitar estímulos novos, preferindo responder a estímulos familiares (e.g., Farthing & Opuda, 1974; Tomonaga, Matsuzawa, Fujita, & Yamamoto, 1991; Zentall, 1996; Zentall, Edwards, Moore, & Hogan, 1981). Para participantes humanos, por outro lado, estímulos novos são particularmente salientes (Zeaman, 1976). No caso das pesquisas com humanos, foco

do presente trabalho, tem-se tentado resolver o problema da novidade garantindo que os participantes tenham alguma exposição aos estímulos antes de apresentá-los nos testes (e.g., Dixon & Dixon, 1978). No entanto, esse tipo de alternativa também apresenta limitações (Dixon, Dixon, & Spradlin, 1983; McIlvane & Stoddard, 1981; Stromer & Osbourne, 1982; Stromer & Stromer, 1989). Ainda que os participantes tenham algum tipo de experiência anterior com os estímulos “novos”, durante os testes o efeito da novidade pode ser controlado pelo contexto. Ou seja, uma vez apresentados em um contexto novo, estímulos previamente utilizados serão sempre novos. Por isso, o controle pela novidade deve ser sempre considerado (McIlvane et al., 1984, p.237).

Carrigan e Sidman (1992) também apresentam críticas ao uso de testes com estímulos novos. Os autores lançam a seguinte pergunta: tendo um participante que na linha de base responde sob controle por rejeição, como esse se comportaria diante dos testes para ocorrência de controle por seleção nos quais os estímulos que controlaram o responder (S-) são substituídos por estímulos novos? Foram levantadas duas possibilidades: a) na ausência de uma comparação familiar para rejeitar, o participante pode vacilar ao longo das tentativas, escolhendo ora o S+, ora o estímulo novo. Tal resultado (responder ao nível do acaso) serviria, ainda, como um indicador de controle por rejeição. No entanto, considerando a história de linha de base, na qual o participante aprendeu que a cada tentativa apenas um estímulo comparação deve ser escolhido em acordo com o modelo apresentado, b) o participante pode eleger arbitrariamente uma comparação para cada um dos modelos e escolhê-los sistematicamente (Saunders, Saunders, Kirby, & Spradlin, 1988). Dessa forma, nos testes, o participante pode escolher B1 diante de A1 e B2 diante de A2 mesmo tendo rejeitado B2 diante de A1 e B1 diante de A2 durante toda a linha de base. Embora os resultados desse teste pareçam atestar o controle por seleção durante a linha de base, tal resultado seria inválido, considerando que o responder, durante o treino, era

controlado pelo S- programado. Os testes com estímulos novos podem, ainda, c) “ensinar” novos controles. Mesmo tendo aprendido a "rejeitar" B2 diante de A1, o participante pode se "lembrar" de que B1 sempre foi apresentado junto de B2. Tendo isso em vista, quando B2 for substituído por um estímulo novo em um teste para verificar controle por seleção, o participante pode aprender a "selecionar" B1 diante de A1.

Por fim, Carrigan e Sidman (1992) concluem que testes com estímulos novos podem não refletir acuradamente o tipo de controle estabelecido durante o treino. No entanto, é importante pontuar que a crítica apontada por esses autores só se aplica aos casos em que o estímulo que controla o responder é substituído por um estímulo novo. Nos casos em que o controle por rejeição é estabelecido de forma exclusiva em todas as tentativas e o S+ é substituído por um estímulo novo durante o teste, apenas o controle pela novidade deve ser considerado. Ainda, nos casos em que controle por seleção se estabelece de forma exclusiva e o S+ continua a ser escolhido mesmo quando o S- é trocado por um estímulo novo, o controle por seleção pode ser atestado.

Embora o teste com estímulos novos tenha recebido críticas (e.g. Carrigan & Sidman, 1992), experimentos recentes continuam a utilizá-lo como medida de controle pelo S+ ou S- (e.g., Carr et al., 2000; Goulart et al., 2005; Kato et al., 2008; de Rose et al., no prelo).

Testes com máscara. A chance de que estímulos novos sejam selecionados pelo fato de não serem familiares ao participante (controle pela novidade) deve ser sempre considerada. Tal possibilidade de controle enfraquece os resultados dos testes com estímulos novos como evidências de controle por rejeição. Isso se dá porque, em tais testes, o controle por rejeição é inferido justamente com base na escolha sistemática

de estímulos novos apresentados junto de um modelo e um comparação, que é supostamente "rejeitado" (McIlvane et al., 1984).

De modo a evitar o controle pela novidade, McIlvane et al. (1984) desenvolveram o procedimento de máscara (como comumente é chamado no Brasil; chamado de *blank-comparison* em McIlvane et al., 1984 ou *single-comparison* em McIlvane, Kledaras, Munson, King, de Rose, & Stoddard, 1987). Esse procedimento foi utilizado e aprimorado em estudos posteriores (Goulart et al., 2005; McIlvane et al., 1987; McIlvane, Kledaras, Lowry, & Stoddard, 1992; O'Donnell & Saunders, 1994; Serna et al., 1998; Wilkinson, Dube, & McIlvane, 1996; Wilkinson & McIlvane, 1997). Nos testes com o procedimento de máscara, em vez de estímulos novos, são utilizados quadrados monocromáticos (máscaras) que, gradualmente (ver Figura 3), passam a encobrir o estímulo ao longo das tentativas. Tal inserção gradual controlaria o efeito da novidade. De forma idêntica ao teste com estímulos novos, quando se pretende avaliar o estabelecimento do controle por seleção, o S- é coberto pela máscara e escolhas do S+ são tomadas como evidências de controle por seleção; quando se pretende avaliar o estabelecimento do controle por rejeição, o S+ é coberto pela máscara e a escolha sistemática dessa última sugere a ocorrência do controle por rejeição.

McIlvane et al. (1984) ensinaram quatro participantes com desenvolvimento atípico a responder em tarefas de MTS auditivo-visual e visual-visual. Depois de atingirem o critério de desempenho desejado no treino das relações condicionais, os participantes receberam testes para verificar a ocorrência dos controles por seleção e por rejeição. De modo geral, os participantes demonstraram ambos os controles. Nos testes em que a máscara cobriu o S-, o S+ foi selecionado sistematicamente, atestando controle por seleção; nos testes em que a máscara cobriu o S+, a máscara foi selecionada, atestando controle por rejeição. Os autores concluíram, por fim, que esse tipo de procedimento controla o efeito da novidade e permite que os controles

por seleção e por rejeição sejam inferidos a partir das escolhas realizadas pelos participantes.

TREINO											
AB											
A1				A2							
<u>B1</u>		B2		B1		<u>B2</u>					
FADING IN DA MÁSCARA											
TESTE DE CONTROLE POR SELEÇÃO						TESTE DE CONTROLE POR REJEIÇÃO					
<u>B1</u>	A1			A2	<u>B2</u>	<u>B1</u>	A1	B2	B1	A2
<u>B1</u>	A1			A2	<u>B2</u>	<u>B1</u>	A1	B2	B1	A2
<u>B1</u>	A1			A2	<u>B2</u>	<u>B1</u>	A1	B2	B1	A2
<u>B1</u>	A1			A2	<u>B2</u>	<u>B1</u>	A1	B2	B1	A2
<u>B1</u>	A1			A2	<u>B2</u>		A1	B2	B1	A2

Figura 3. Dado um treino AB, são realizados testes para verificar o controle estabelecido. Nos testes para verificar o controle por seleção, uma máscara gradualmente encobre o S-; a escolha do S+ serve de evidência de controle por seleção. Nos testes de controle por rejeição, uma máscara gradualmente encobre o S+; a escolha da máscara serve de evidência de controle por rejeição. Para uma outra forma de realizar o *fading in* do quadrado preto, ver Wilkinson e McIlvane (1997).

Movimentos dos olhos. Alguns estudos mostraram que o olhar dos participantes pode ser utilizado como uma medida na investigação do controle de estímulo (e.g., Dube et

al., 2003; 2006; 2010; Pessoa, Huziwara, Perez, Endemann, & Tomanari, 2008; Schroeder, 1970). Magnusson (2002), em uma replicação sistemática de Johnson e Sidman (1993), submeteu seus participantes a duas fases experimentais nas quais, para diferentes conjuntos de estímulos, o controle por seleção ou por rejeição foi estabelecido. O autor identificou dois padrões de olhar, isto é, sequências de observação antes da ocorrência da resposta de escolha, que se diferenciaram a depender do controle em vigor. Na fase experimental em que controle por seleção foi estabelecido, os participantes realizavam suas escolhas tendo olhado somente para o S+. Na fase em que o controle se dava por rejeição, os participantes escolhiam o S+ tendo olhado somente o S-, ou seja, escolhiam o S+ sem observá-lo. Para o participante que apresentou uma maior frequência desses padrões, na fase de controle por rejeição, quando o S- era o primeiro estímulo observado, em 74% das tentativas as escolhas foram realizadas sem que o S+ fosse observado. Na fase de controle por seleção, o S+ foi observado e seguido da resposta de escolha em 89,1% das tentativas.

Dando continuidade ao estudo de Magnusson (2002), Perez (2008) investigou não só os padrões de olhar, mas também a frequência e a duração do olhar para o S+ e para o S- a depender do controle estabelecido, por seleção ou por rejeição. Os resultados encontrados para um dos participantes corroboram os de Magnusson com relação ao padrão do olhar. Para esse mesmo participante, na fase de controle por seleção, a frequência e a duração total do olhar durante a sessão foi maior para o S+ quando comparado ao S-; na fase de controle por rejeição foi observado o inverso, ou seja, maior frequência e duração do olhar para o S-.

Os estudos de Magnusson (2002) e Perez (2008) mostram que os movimentos dos olhos podem ser indicadores dos controles em vigor ao longo do treino. Considerando que os testes de equivalência, teste com estímulos novos ou teste com máscara só são realizados depois da obtenção de um responder estável

durante o treino, acompanhar o movimento dos olhos do participante pode ser uma vantagem, já que permite que os controles por seleção e por rejeição sejam acompanhados no momento em que ocorrem, tentativa a tentativa. Para que isso seja realizado, no entanto, faz-se necessário alterar alguns parâmetros da tarefa. Nos estudos citados (Magnusson, 2002; Perez, 2008), o tamanho dos estímulos utilizados foi reduzido quando comparado com a maioria dos estudos da área. Tal modificação foi realizada de modo a favorecer que o participante fixasse o olhar sobre os estímulos, evitando que respostas de escolha fossem emitidas por meio da visão periférica (cf. Pessoa et al., 2009). Os dados de outro estudo sugerem que, quando os estímulos são utilizados nas medidas usualmente adotadas pela literatura, os movimentos dos olhos podem não apresentar diferenças que permitam identificar os controles por seleção ou por rejeição (Huziwara, 2010). Ainda, o efeito da visão periférica pode permitir que as respostas às comparações sejam emitidas sem que eles sejam fixados (Perez, 2008).

MTS com observação requerida (MTS-OR). A análise da observação dos estímulos pode ser realizada, ainda, por meio do procedimento de MTS com observação requerida (Hamasaki, 2009). Tal procedimento consiste em cobrir todos os estímulos (modelo e comparações) com uma *janela* que pode ser aberta pelo participante por meio do clique do *mouse* sobre um botão localizado abaixo da área de apresentação do estímulo. Um clique sobre esse botão (resposta de observação) produz a abertura da janela, permitindo que o estímulo seja observado por um tempo determinado, por exemplo 0,2 s. No Experimento 1 de Hamasaki (2009), três participantes foram submetidos a um treino AB/BC seguido de testes de equivalência, simetria e transitividade. Três comparações foram utilizados. Durante os testes, todos os participantes responderam em acordo com as classes planejadas. Nesse procedimento, os controles por seleção e por rejeição podem ser inferidos a partir das

respostas de observação ocorridas a cada tentativa. O controle por seleção pode ser inferido quando a escolha do S+ é realizada a partir da observação somente do S+, na ausência de respostas de observação aos comparações com função de S-. O controle por rejeição, por sua vez, pode ser inferido quando respostas de observação são emitidas a ambos os S- e, além disso, o S+ é escolhido sem ser observado. Todos os participantes nesse estudo, em algumas tentativas, realizaram escolhas tendo observado somente o S+. Dois dos três participantes também realizaram escolhas tendo observado somente os S-. Sendo assim, as respostas de observação emitidas durante o treino por um dos participantes sugerem o estabelecimento somente do controle por seleção. As respostas de observação dos dois demais participantes sugerem o estabelecimento de ambos os controles, tanto por seleção quanto por rejeição.

Sobre as Implicações dos Controles por Seleção e por Rejeição e a Necessidade de Manipulação Experimental desses Controles

O controle por seleção é sempre privilegiado pela própria contingência programada, já que respostas de escolha ao S+ são reforçadas. Esse é usualmente (salvo exceções, e.g., Johnson & Sidman, 1993) o controle de estímulo alvo dos experimentos em equivalência. O controle por rejeição, por outro lado, tem sido tomado como uma variável interveniente (por exemplo, correlacionada a falhas na formação das classes programadas pelo experimentador, cf. Carrigan & Sidman, 1992; Johnson & Sidman, 1993; Sidman, 1987). Alternativamente, alguns estudos sugerem que os chamados comportamentos complexos podem ser função da ocorrência de ambos os controles, tanto por seleção quanto por rejeição. Quando submetidos a treinos de controle pela identidade ou singularidade, nos quais um estímulo modelo é apresentado junto de dois comparações, um igual a ele e outro diferente, pombos usualmente respondem sob controle do S+, mas não do S-. Sujeitos

que apresentaram esse desempenho em estudos anteriores também falharam nos testes de identidade generalizada, ou seja, não responderam sob controle da identidade ou da diferença entre modelo e comparação quando novos estímulos foram apresentados (Berryman et al., 1965; Carter & Werner, 1978; Cumming & Berryman, 1961, 1965; Urcuioli, 1977; Urcuioli & Nevin, 1975). Por outro lado, quando os sujeitos foram especificamente treinados a responder sob controle de ambas as comparações, ou seja, a responder por seleção e por rejeição, foram encontradas evidências de controle generalizado (Santi, 1982; Urcuioli, 1977; Urcuioli & Nevin, 1975).

Ambos os controles também parecem estar envolvidos no aprendizado por exclusão, *fast mapping* ou *emergent symbolic mapping* (Wilkinson et al., 1996, 1997). No aprendizado por exclusão (e.g., Dixon, 1977; Dixon & Dixon, 1978; McIlvane, Munson, & Stoddard, 1988; McIlvane & Stoddard, 1981), de modo geral, um estímulo comparação previamente utilizado no treino é apresentado junto de um modelo e um outro comparação novos. Humanos diante dessa situação (de Rose, Souza, & Hanna, 1996; Domeniconi, Costa, Souza, & de Rose, 2007; Ferrari, de Rose, & McIlvane, 1993; McIlvane, Kledaras, Lowry, & Stoddard, 1992) usualmente escolhem o comparação novo diante do modelo novo, desempenhando uma relação inédita. Tal resposta, no entanto, pode ser controlada tanto pela seleção dos estímulos novos quanto pela rejeição do estímulo conhecido (cf. McIlvane et al., 1987, 1988). McIlvane et al. (1987; 1988) apresentam dados que sugerem que os participantes que apresentam um responder generalizado sob controle tanto do S+ quanto do S- apresentam melhores resultados nas tentativas de exclusão. Se ambos os controles estão presentes, o participante desempenha novas relações em acordo com a contingência programada tanto nas tentativas em que um modelo e um comparação novos são apresentados junto de um comparação conhecido quanto nas tentativas em que um modelo e um comparação S- conhecidos são apresentados junto de um outro comparação novo. De acordo com Wilkinson et al. (1996), os estudos sobre

aprendizado por exclusão têm sido de interesse primordial nas pesquisas sobre aquisição da linguagem. É possível que a rápida aquisição de repertório verbal que ocorre na infância esteja relacionada a processos de aprendizagem como os descritos por esses estudos, ou seja, à ocorrência tanto do controle por seleção quanto por rejeição. Dessa forma, do ponto de vista da Análise do Comportamento, faz-se necessário avaliar quais os controles envolvidos nesse processo. Para tanto, o desenvolvimento de procedimentos que avaliem ou isolem os controles por seleção e por rejeição têm sido o foco em algumas dessas pesquisas (e.g. Wilkinson et al., 1996; Wilkinson & McIlvane, 1997).

Por fim, resta saber as implicações e a relevância de se estudar os controles por seleção e por rejeição no contexto da formação de classes de estímulos equivalentes. Um ponto evidente, que já foi apresentado anteriormente, reside no fato de que o controle exclusivo por rejeição pode determinar a formação de outras classes que não foram programadas pelo experimentador (Carrigan & Sidman, 1992; Johnson & Sidman, 1993; Magnusson, 2002; Perez, 2008). No entanto, ainda não é possível afirmar que o estabelecimento do controle por rejeição seja "indesejável" no ensino das discriminações condicionais necessárias à emergência das classes de equivalência. Na medida em que ao longo das tentativas a função das comparações passa a ser alternada pelo modelo apresentado, de algum modo, a noção de condicionalidade implica o aprendizado de ambos os controles. Alguns estudos apontam que os participantes que apresentam melhores resultados nos testes de equivalência são justamente aqueles que, durante os testes que visam verificar a ocorrência do controle por seleção e por rejeição, apresentam resultados que sugerem o estabelecimento de ambos os controles durante o treino das discriminações condicionais (Arantes, 2008; Carr et al., 2000; Kato et al., 2008; de Rose et al., no prelo). Em um desses estudos (Carr et al., 2000), um dos poucos a apresentar dados de formação de classes com indivíduos com repertório verbal mínimo, quatro

indivíduos que apresentaram resultados positivos nos testes de formação de classes também apresentaram resultados positivos nos testes para verificar a ocorrência tanto do controle por seleção quanto por rejeição. Outros estudos, ainda, indicam que o estabelecimento de um responder condicional generalizado, que agiliza o aprendizado em tarefas de MTS, pressupõe a ocorrência de ambos os controles (Saunders & Spradlin, 1990, 1993; Saunders & Williams, 1998).

A maioria dos estudos citados na sessão anterior do presente artigo, muitos deles recentes, inferiu o estabelecimento do controle por seleção e por rejeição por meio de testes realizados depois de o participante apresentar um responder estável durante o treino. Tais testes, no entanto, tal como descritos até aqui, não permitem manipular tais controles. Por meio desses testes, é possível somente inferir a sua ocorrência ou não, possibilitando a interpretação dos resultados em função do arranjo experimental programado. Como sugerido por diversos pesquisadores (Goulart et al., 2005; Lionello-DeNolf, 2009; Perez, 2008; Perez & Tomanari, 2008), parte das questões referentes ao papel do controle por seleção e por rejeição na formação de classes não foi respondida pelo fato de que tais controles, na maioria dos estudos, não foram manipulados experimentalmente, mas apenas tiveram o seu estabelecimento atestado depois de realizado o treino. Na medida em que poucos estudos publicados (de Rose, et al., no prelo; Goulart et al., 2005; Johnson & Sidman, 1993) se dedicaram à manipulação experimental dos controles por seleção ou rejeição durante o treino, existem poucos dados acerca dos seus efeitos sobre a formação de classes de equivalência (para teses e dissertações não publicadas, ver Arantes, 2008; Hamasaki, 2009; Magnusson, 2002; Perez, 2008; Vasconcellos, 2003).

Manipulação Experimental do Controle por Seleção e/ou por Rejeição

A seguir, será apresentada uma revisão dos parâmetros e procedimentos utilizados para favorecer o estabelecimento dos controles por seleção e/ou rejeição durante o treino das relações condicionais.

Parâmetros do treino que podem influenciar o estabelecimento do controle por seleção ou por rejeição. Antes de apresentar os procedimentos que são utilizados para favorecer o estabelecimento do controle por seleção e por rejeição, serão descritos alguns parâmetros que podem influenciar o estabelecimento de um controle ou de outro. Dentre esses parâmetros, encontra-se o número de comparações apresentados simultaneamente em uma mesma tentativa. De acordo com Sidman (1987; Doan, Martin, Yu, & Martin, 2007; ver também de Rose, Kato, Thé, & Kledaras, 1997, para uma revisão), quando dois estímulos de comparação são utilizados, o controle por rejeição é favorecido ou, pelo menos, os controles por seleção e por rejeição se tornam equiprováveis. À medida que o número de comparações apresentados aumenta e, com isso, o número de S- apresentados simultaneamente, o controle por seleção se torna mais provável, já que o número de relações que precisam ser aprendidas para que o controle por rejeição seja seguido de reforço cresce a cada comparação adicionado.

Outro parâmetro importante é a topografia de resposta utilizada (de Rose et al., 1997; Kato et al., 2008). Como sugerido por de Rose et al. (1997), "responder com o *mouse* requer uma resposta de orientação ao estímulo escolhido (o S+). Quando as escolhas são realizadas por meio do teclado, existe a possibilidade de que o sujeito olhe para o S- e então rejeite este estímulo pressionando a tecla correspondente ao estímulo alternativo" (de Rose et al., 1997, p. 154), no caso, o S+. No estudo de Kato et al. (2008), realizado com universitários, o grupo de participantes que fez o uso do *mouse* apresentou maior sucesso na formação de classes quando comparado com o grupo que fez uso do teclado. Os resultados dos testes com estímulos novos sugerem,

ainda, que o uso do mouse aumentou a probabilidade do estabelecimento do controle por seleção quando comparado ao teclado. O uso do teclado, no entanto, não necessariamente foi seguido de resultados que sugerissem o estabelecimento do controle por rejeição. O procedimento de Kato et al. (2008) foi sistematicamente replicado por Huziwara (2010). Nesse último estudo, o movimento dos olhos dos participantes foi registrado enquanto eles eram submetidos ao procedimento. Embora não tenham sido encontradas diferenças com relação ao estabelecimento dos controles por seleção ou rejeição a depender da topografia de resposta utilizada, foram encontradas diferenças com relação à observação dos estímulos. De acordo com Huziwara (2010), o uso do mouse promove uma maior duração da observação quando comparado ao teclado.

Diferentes proporções de S+ e S-. Carrigan e Sidman (1992), em um artigo teórico, sugerem um procedimento capaz de favorecer o estabelecimento do controle por seleção ou por rejeição. Tal procedimento consiste em aumentar a proporção de S+ ou S- a depender do controle que se pretende produzir. Como mostra a Tabela 2, em um treino que visa tornar mais provável o controle por seleção, o número de comparações programado como S- pode, por exemplo, ser quatro vezes maior do que o número de comparações S+. Dessa forma, para atingir o critério de encerramento do treino, o participante poderá responder sob controle de quatro relações “modelo-comparação S-” (rejeição) ou sob controle de apenas uma relação “modelo-comparação S+” (seleção). De forma análoga, em um treino que visa tornar mais provável o controle por rejeição, o número de comparações S+ deveria ser quatro vezes maior do que o número de comparações S-. Dessa forma, para atingir o critério de encerramento do treino, o participante poderá responder sob controle de quatro relações “modelo-comparação S+” (seleção) ou de apenas uma relação “modelo-comparação S-” (rejeição).

Tabela 2. À esquerda, tentativas com uma maior proporção de S-, visando favorecer o controle pelo S+ (seleção). À direita, tentativas com uma maior proporção de S+, visando favorecer o controle pelo S- (rejeição).

<i>Seleção</i>			<i>Rejeição</i>		
Modelo	Comparações		Modelo	Comparações	
	S+	S-		S+	S-
A1	B1	B2	A1	B1	B2
A1	B1	X1	A1	W1	B2
A1	B1	X2	A1	W2	B2
A1	B1	X3	A1	W3	B2
A2	B2	B1	A2	B2	B1
A2	B2	X4	A2	W4	B1
A2	B2	X5	A2	W5	B1
A2	B2	X6	A2	W6	B1
B1	C1	C2	B1	C1	C2
B1	C1	Y1	B1	Z1	C2
B1	C1	Y2	B1	Z2	C2
B1	C1	Y3	B1	Z3	C2
B2	C2	C1	B2	C2	C1
B2	C2	Y1	B2	Z4	C1
B2	C2	Y2	B2	Z5	C1
B2	C2	Y3	B2	Z6	C1

Para descrever em termos de programação o uso desse procedimento, considera-se um treino (AB, por exemplo) no qual um modelo (A1) é apresentado simultaneamente a dois comparações, um S+ (B1) e um S- (B2). A depender do controle que se pretende instalar, novos S+ (W1, W2, W3) ou S- (X1, X2, X3) são apresentados no decorrer das tentativas. Quando o controle por seleção é visado, o S+ (B1) é sempre apresentado e, a cada tentativa, um dos quatro S- (B2, X1, X2, X3) é apresentado simultaneamente a ele; ou seja, a cada tentativa, o S+ é apresentado

junto de um S- diferente. Quando o controle por rejeição é visado, o S- (B2) é sempre apresentado e, a cada tentativa, um dos quatro S+ (B1, W1, W2, W3) é apresentado simultaneamente a ele; ou seja, a cada tentativa, o S- é apresentado junto de um S+ diferente.

A hipótese de que o controle por rejeição seria seguido por resultados negativos nos testes de reflexividade, transitividade e equivalência (Carrigan & Sidman, 1992) foi testada experimentalmente por Johnson e Sidman (1993), fazendo uso do procedimento descrito acima. Três adultos foram submetidos a um treino de discriminação condicional por meio de tentativas de MTS com dois comparações. Figuras sem sentido foram utilizadas como estímulos. De modo a favorecer o estabelecimento do controle por rejeição durante o treino, foram utilizadas diferentes proporções de S+ e S- (Carrigan & Sidman, 1992 – ver Tabela 2), bem como um procedimento adicional de dica atrasada (que será descrito em uma sessão separada). Nesse procedimento, o S+ desaparecia da tela e era substituído por um quadrado branco que poderia ser escolhido como comparação.

Inicialmente, foi realizado um treino AB/BC. Uma vez atingido o critério de aprendizagem, na sequência, foram realizados testes de simetria (BA e CB), transitividade (AC) e equivalência (CA). Depois dos testes para a linha de base AB/BC, foram ensinadas as relações CD. Uma vez atingido o critério em um treino com todas as relações AB/BC/CD, foram realizados testes de simetria (BA, CB e DC), transitividade (AC, BD e AD) e equivalência (CA, DB e DA). Para um dos participantes, foi realizado o teste de reflexividade (AA, BB, CC e DD). Em todas as fases do experimento, um estímulo modelo era apresentado no centro da tela simultaneamente a dois comparações, cuja posição variava randomicamente nos quatro cantos do monitor. Foram utilizadas, como estímulos, figuras pretas sem sentido sob um fundo branco.

Os resultados observados por Johnson e Sidman (1993) confirmam as previsões de Carrigan e Sidman (1992). De modo geral, os participantes falharam nos testes de reflexividade (AA, BB, CC e DD), transitividade (AC e BD) e equivalência (CA e BD), nos quais conjuntos de estímulos eram relacionados entre si a partir de um único nodo. Nos testes de simetria, transitividade e equivalência, nos quais conjuntos de estímulos eram relacionados a partir de dois nodos, os participantes obtiveram alta porcentagem de acertos. Isso confirma que o número de nodos é um parâmetro crítico no uso dos testes de equivalência como medida do controle (seleção/rejeição) estabelecido durante o treino. Os autores discutem que o estabelecimento do controle por rejeição levou à formação de classes de estímulos equivalentes (A1B2C1D2 e A2B1C2D1) distintas daquelas esperadas a partir do treino realizado (A1B1C1D1 e A2B2C2D2).

Johnson e Sidman (1993) fizeram uso do procedimento sugerido por Carrigan e Sidman (1992) apenas para modelar o controle por rejeição. Magnusson (2002) utilizou o mesmo procedimento para modelar tanto o controle por seleção quanto por rejeição. Os resultados corroboram o estudo de Johnson e Sidman (1993) e mostram, ainda, que o procedimento sugerido por Carrigan e Sidman (1992) também é eficiente para facilitar o estabelecimento do controle pelo comparação programado como S+.

Embora Johnson e Sidman (1993) e Magnusson (2002) tenham conseguido favorecer o estabelecimento dos controles em questão, o procedimento de diferentes proporções de S+ e S- foi utilizado conjuntamente com o procedimento de dica atrasada (apresentado e discutido na próxima sessão). Perez (2008) visou estabelecer os controles por seleção ou rejeição utilizando somente diferentes proporções de S+ e S-. Todos os quatro participantes submetidos às contingências programadas apresentaram controle por seleção na fase em que o estabelecimento desse controle foi favorecido. No entanto, apenas um deles apresentou resultados típicos de rejeição,

tal como relatado nos demais estudos (Johnson & Sidman, 1993; Magnusson 2002). Tais resultados sugerem que o uso de diferentes proporções de S+ e S- pode não ser eficiente para estabelecer o controle por rejeição na ausência do procedimento de dica atrasada.

O'Donnell e Saunders (1994), por outro lado, fizeram uso de diferentes proporções de S+ e S- na tentativa de alterar um controle inadvertidamente estabelecido por S-. Dessa forma, aumentaram o número de S- apresentados de modo a favorecer o controle por seleção no responder de um participante com retardo moderado. O controle pelo S- se manteve. Os autores discutem a possibilidade de que o procedimento pode ser eficaz para favorecer o estabelecimento dos controles planejados, mas pode ser insuficiente para alterar aqueles já estabelecidos. Além disso, os autores apontam que o uso de múltiplas comparações com uma mesma função pode gerar um controle pela frequência de apresentação. O participante, dessa forma, pode aprender a rejeitar as comparações apresentadas menos frequentemente, em vez de aprender a selecionar o S+.

Perez e Tomanari (2011) tentaram estabelecer o controle por rejeição utilizando uma maior proporção de S+ ao longo das tentativas. Dos cinco universitários submetidos ao procedimento, três não atingiram o critério de encerramento do treino de duas relações condicionais (modelo/S-), mesmo depois de realizarem nove sessões de 64 tentativas. Os dois participantes que encerraram o treino, durante os testes de equivalência, não apresentaram desempenhos típicos de rejeição (cf. Carrigan & Sidman, 1992). Os autores discutem que, no procedimento de proporções de S+ e S-, na medida em que o S+ varia ao longo das tentativas, o participante pode aprender a responder aleatoriamente, e não sob controle das relações modelo/S- sistematicamente apresentadas.

Dica atrasada e dica do S+. Como foi pontuado anteriormente, tanto Johnson e Sidman (1993) quanto Magnusson (2002), além do uso de diferentes proporções de S+/S- ao longo das tentativas (cf. Carrigan & Sidman, 1992), também fizeram uso de um procedimento de dica atrasada, adaptado de estudos anteriores (Sidman, 1977; Touchette, 1971).

De modo a favorecer o estabelecimento do controle por seleção, no procedimento de dica atrasada, transcorrido um dado intervalo na ausência de respostas do participante, o comparação programado como S- desaparece da tela enquanto o S+ fica disponível para que o participante emita a resposta de escolha. Em contrapartida, de modo a favorecer o estabelecimento do controle por rejeição, transcorrido o intervalo, o comparação programado como S+ é substituído por um quadrado branco e somente aquele programado como S- permanece na tela. Respostas ao quadrado branco são seguidas das consequências programadas para o S+ (ver Figura 4).

Figura 4. Supõe-se um treino AB com procedimento de dica atrasada. Depois de apresentados o modelo e os comparações, visando favorecer o controle por seleção, somente o S+ fica disponível para ser escolhido. Caso o controle por rejeição seja

visado, o S+ é substituído por um quadrado branco que pode ser escolhido. O intervalo de tempo necessário ao desaparecimento dos estímulos pode variar e frequentemente é aumentado, gradualmente, ao longo das tentativas.

Embora tal procedimento tenha sido utilizado (Johnson & Sidman, 1993; Magnusson, 2002) aliado ao procedimento sugerido por Carrigan e Sidman (1992), de modo a garantir que as relações de controle desejadas fossem produzidas, não é possível saber ao certo o que produziu os resultados: a diferença na proporção de S+ ou S- ou o procedimento de dica atrasada. Para tanto, faz-se necessário que tais procedimentos sejam utilizados e testados separadamente (cf. Perez & Tomanari, 2011).

Outro procedimento similar à dica atrasada é a dica do S+ (Lionello-DeNolf, Barros, McIlvane, 2008; McIlvane et al., 2002; McIlvane, Kledaras, Dube, & Stoddard, 1989). Nesse procedimento, transcorrido um dado intervalo depois da apresentação do S+ e do S-, o S+ é evidenciado por meio do acionamento de uma luz que se mantém acesa (Lionello-DeNolf et al., 2008) ou piscante (McIlvane et al., 1989; McIlvane et al., 2002).

O uso da dica atrasada e da dica do S+ tem permitido que o controle discriminativo seja estabelecido de modo eficaz, em especial para participantes com desenvolvimento atípico. Lionello et al. (2008) sugerem que o uso conjugado desses dois procedimentos pode ser ainda mais eficaz na modelagem do controle de estímulo.

Treino com máscara. O procedimento de máscara foi desenvolvido para testar a ocorrência dos controles por seleção e por rejeição evitando o efeito da novidade do estímulo. No entanto, tal procedimento pode ser utilizado para se impedir o estabelecimento do controle por um dos comparações, que fica encoberto,

favorecendo o controle pelo outro, que fica visível (Arantes, 2008; de Rose et al., no prelo; Goulart et al., 2005; Vasconcellos, 2003). Para tanto, em vez de os estímulos serem encobertos em algumas tentativas de teste depois do estabelecimento do responder discriminado, tal procedimento pode ser realizado desde o início das tentativas de treino (Arantes, 2008; de Rose et al., no prelo; Goulart, et al., 2005; Vasconcelos, 2003). Quando o controle por seleção é favorecido, em cada tentativa um quadrado preto encobre o S-; quando o controle por rejeição é visado, o quadrado encobre o comparação programado como S+ e respostas ao quadrado são seguidas de consequências programadas para "acerto".

de Rose et al. (no prelo), submeteram quatro crianças a um treino AB, BC e CD. Na primeira fase do experimento, de modo a favorecer que ambos os controles por seleção e por rejeição se estabelecessem para todos os pares de estímulo, uma máscara encobriu em 50% das tentativas o S+ (favorecendo o controle por rejeição) e em 50% das tentativas o S- (favorecendo o controle por seleção). Na sequência, foram realizados testes de equivalência DA, CA e DB. Na segunda fase, foram utilizados outros estímulos e o procedimento foi repetido, exceto pelo fato de que, no treino das relações BC, o S+ foi encoberto em todas as tentativas, favorecendo o estabelecimento somente do controle por rejeição.

Os resultados apontam que, quando o treino favoreceu o estabelecimento de ambos os controles (seleção e rejeição), todos os participantes apresentaram altos escores nos testes de equivalência (primeira fase). Por outro lado, quando o controle entre os conjuntos BC se deu exclusivamente por rejeição (segunda fase), dois participantes não apresentaram desempenhos emergentes nos testes de equivalência – como previsto por Carrigan e Sidman (1992). Ainda assim, os dois participantes restantes apresentaram desempenhos de formação de classes.

Goulart et al. (2005, Experimento 2), de modo a favorecer o estabelecimento dos controles por seleção e por rejeição, submeteram dois macacos a um treino AB no

qual, em dois terços das tentativas, o S+ ou o S- era coberto pela máscara em 50% das apresentações. Depois de realizado o treino, os sujeitos foram submetidos a testes nos quais a máscara era substituída por estímulos novos. Os resultados sugerem que ambos os sujeitos apresentaram tanto controle por seleção quanto por rejeição.

Quando ambos os controles são visados, o uso do procedimento de máscara não apresenta problemas e parece favorecê-los adequadamente (e.g. Goulart et al., 2005). No entanto, quando somente a seleção ou a rejeição é visada durante o treino, o uso desse procedimento pode gerar um controle espúrio pelo quadrado que encobre o estímulo. Suponhamos um treino AB no qual A1 é apresentado como modelo, B1 e B2 como comparações. Se o controle por rejeição é visado, B1 deve ser encoberto em, por exemplo, 50% das tentativas (como em de Rose et al., no prelo). Tal manipulação, no entanto, pode ensinar o participante a, diante de A1, responder sob controle tanto de B1 quanto do quadrado que o encobre ocasionalmente. Dessa forma, embora o participante seja impedido de observar B1 em algumas tentativas, o S-, B2, não necessariamente adquire controle sobre o responder (Perez & Tomanari, 2011). Quando ambos os controles são visados, tal problema não ocorre. Isso se dá pelo fato de que a máscara ora está sobre o S+, ora sobre o S-. Ou seja, respostas de escolha baseadas na máscara são seguidas de reforço em somente 50% das tentativas, o que a torna um estímulo ambíguo.

Cabe pontuar, ainda, que a manipulação da observação no procedimento máscara é fraco. Impedir o participante de observar um dos estímulos encobrindo-o com um quadrado preto não garante que o estímulo descoberto controle o responder. Para isso, deveria se garantir que as respostas de observação fossem emitidas em relação ao estímulo que deve controlar o responder (S+ na seleção; S- na rejeição), e não somente evitar que sejam observados os estímulos para os quais o controle do

responder deve ser prevenido. Isso, no entanto, não foi exigido nos estudos citados até aqui. Uma alternativa metodológica com esse objetivo é apresentada a seguir.

Variações do procedimento MTS com observação requerida (MTS-OR). Por meio de variações no procedimento MTS-OR, Hamasaki (2009) pretendeu favorecer, para diferentes grupos de participantes, o estabelecimento dos controles por seleção ou por rejeição manipulando a resposta de observação. No Experimento 2, Hamasaki “travou” a janela de um dos dois S- (grupo seleção) ou do S+ (grupo rejeição) em 70% das tentativas, a depender do grupo de participantes, de modo a impedir que esses estímulos pudessem ser observados. Todos os seis participantes alcançaram o critério de aprendizagem no treino das relações condicionais. Na fase de testes, dois dos três participantes que foram impedidos de observar um dos dois S- (Grupo Seleção) apresentaram alta porcentagem de acertos nos testes de equivalência, simetria e transitividade. O estabelecimento do controle por seleção foi indicado pelo sucesso no teste de equivalência e transitividade (cf. Carrigan & Sidman, 1992), aliado aos fatos de que nenhuma resposta foi realizada sem que o S+ fosse observado e de que, em algumas tentativas em que o S+ era o primeiro estímulo observado, esse já era escolhido sem que nenhuma outra janela fosse aberta. No caso do outro grupo, cujos participantes foram impedidos de observar o S+ (Grupo Rejeição), todos os três participantes apresentaram um responder ao acaso nos testes de equivalência e transitividade. No entanto, considerando que nenhuma resposta de escolha foi realizada dada a observação somente dos S-, a ocorrência do controle por rejeição não pode ser inferida.

No Experimento 3, foi manipulada a ordem de observação do S+ e dos S-. Para um grupo de participantes, o S+ era apresentado na primeira janela aberta pelo participante em 80% das tentativas. Para outro grupo, o S+ só era apresentado na terceira (última) janela aberta. Todos os participantes de ambos os grupos

apresentaram altas porcentagens de acertos nos testes de formação de classes. Para o grupo em que o S+ foi apresentado na primeira abertura, considerando o último bloco de treino, foi realizada uma alta frequência de escolhas dada a observação somente do S+. Nenhum escolha foi realizada dada a observação somente dos S-. Inversamente, para o grupo em que o S+ era apresentado na última abertura, foram verificadas respostas de escolha ao S+ dada a abertura somente dos S-.

Houve ainda dois outros grupos nos quais o S+ era apresentado na primeira ou na última janela aberta pelo participante em 100% das tentativas. Na maioria dos casos, os participantes apresentaram escores medianos nos testes de formação de classes. Discute-se que, quando o S+ é apresentado na primeira ou na última janela aberta pelo participante em todas as tentativas, as respostas de escolha podem ficar sob controle da sequência de abertura, e não do estímulo apresentado, o que prejudicaria a formação de classes.

CONSIDERAÇÕES FINAIS

O presente artigo pretendeu revisar os procedimentos utilizados no estudos dos controle por seleção e por rejeição. Inicialmente, os testes de equivalência, os testes com estímulos novos, os testes com máscara, o rastreamento do movimento dos olhos e o procedimento de MTS com observação requerida foram apresentados e avaliados como alternativas de mensuração desses controles. Em seguida, foram analisados procedimentos que visam manipular o estabelecimento dos controles por seleção ou por rejeição durante o treino. Foram descritos e avaliados o uso de diferentes proporções de S+/S-, os procedimentos de dica atrasada e de dica do S+, a realização do treino com o procedimento de máscara e variações do procedimento de MTS com observação requerida. Alguns parâmetros que podem influenciar o estabelecimento dos controles por seleção e por rejeição, tais como número de comparações apresentados e topografia de resposta, também foram discutidos.

A mensuração da ocorrência dos controles por seleção ou por rejeição é sempre inferida a partir dos testes utilizados. No entanto, como apontado, os testes utilizados frequentemente apresentam problemas metodológicos. Estudos futuros deveriam desenvolver novos testes, visando ampliar as opções de técnicas de mensuração desses controles (Perez & Tomanari, 2008). Estudos anteriores (Carrigan & Sidman, 1992; Johnson & Sidman, 1993) sugeriram que diferentes classes de equivalência são formadas em função do estabelecimento dos controles por seleção ou por rejeição (e.g., A1B1C1, na seleção; A1B2C1, na rejeição). Baseados nessa hipótese, temos utilizado os testes de transferência de função (de Rose, McIlvane, Dube, Galpin, & Stoddard, 1988) como indicadores do estabelecimento do controle pelo S+ ou S- programado (Perez & Tomanari, 2012).

Com relação à manipulação experimental dos controles por seleção e por rejeição, o procedimento de MTS-OR (Hamasaki, 2009) traz contribuições significativas no sentido de permitir a manipulação das respostas de observação aos estímulos de comparação. Essa possibilidade abre uma nova frente de pesquisa no estudo do efeito de manipulações da resposta de observação sobre o estabelecimento dos controles por seleção e/ou por rejeição, visto que possibilita não só impedir a observação do comparação que não foi programado para controlar o responder (como realizado em procedimentos anteriores), mas também permite que a observação do comparação alvo do controle a ser estabelecido seja exigida (S+ no caso da seleção e S- no caso da rejeição). Estudos recentes (Perez & Tomanari, 2011) deram prosseguimento ao estudo de Hamasaki (2009), modificando alguns parâmetros da tarefa de modo a favorecer o estabelecimento e a mensuração do controle por rejeição. Alguns dos parâmetros que já foram investigados são o número de comparações utilizados, o número de respostas exigidas a cada tentativa (Perez & Tomanari, 2012).

Considerando os estudos revisados, é possível verificar que a inferência dos controles por seleção e por rejeição, uma vez realizado o treino das discriminações condicionais, é a estratégia mais presente nas publicações. O número de artigos que visou manipular o estabelecimento desses controles, em vez de somente inferir sua ocorrência depois de já realizado o treino discriminativo, é consideravelmente menor. Com base na revisão apresentada, reitera-se a necessidade de se realizar estudos que busquem manipular experimentalmente o estabelecimento dos controles por seleção e por rejeição durante o treino (cf. Perez & Tomanari, 2008; Goulart et al., 2005; ver também Lionello-DeNolf, 2009). Essa estratégia permitirá avaliar os efeitos desses controles, especialmente sobre a formação de classes de equivalência (cf. de Rose et al., no prelo; Hamasaki, 2009; Perez & Tomanari, 2008).

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CAPÍTULO 2

Manipulating Observing Responses in a Matching-to-Sample Task: Effects on Select and Reject Controls⁴

⁴ Parte desse trabalho foi apresentado em 2011 na 37th Annual Convention of the Association for Behavior Analysis International, realizada em Denver, Colorado, EUA.

Abstract

The establishment of select (sample/S+) or reject (sample/S-) control affects the formation of equivalence classes. The present study evaluated the effects of manipulating observing responses towards comparison stimuli upon the establishment of select or reject controls during training. Participants went through AB/BC conditional discrimination training followed by equivalence tests. A matching-to-sample task with observing requirements (MTS-OR) was used. In this task, all stimuli were hidden behind a window that could be opened by a mouse click on a corresponding button below each of them. Thirty participants were divided into two groups: Reject (n=15) and Select (n=15). During training, participants in the Reject group were required to observe sample and S- in every trial; besides, in different sub-groups (n=5), they were prevented from observing the S+ in 25, 50 or 75% of the total trials in a session. Participants in the Select group were required to observe the sample and the S+ in every trial and were prevented from observing the S- in 25, 50 or 75% of the trials. On equivalence tests, reject-control patterns were observed for four participants on the Reject group and varied as a function of the number of trials in which participants were prevented from observing the S+. Although select-control patterns were found in both groups, they occurred more frequently in the Select group. Reject-control was not found for the Select group.

Keywords: equivalence, select control, reject control, matching-to-sample task with observing requirements, humans.

Manipulating Observing Responses in a Matching-to-Sample Task: Effects on Select and Reject Controls

A stimulus equivalence class is conceptually defined by the substitutability of its members in relation to the control of behavior (Sidman, 2000). In terms of procedure, it is usually studied by establishing a certain set of conditional discriminations in a matching-to-sample task (MTS) and evaluating if class-consistent responses occur whenever stimuli from the same class are presented in novel combinations and/or sequences. For example, having three sets of two different stimuli in each, A (A1, A2), B (B1, B2) and C (C1, C2), conditional relations can be taught by presenting a given stimulus from one set (A: A1 or A2) as a sample along with stimuli from another set (B: B1 and B2) as comparisons and reinforcing responses to the comparison stimulus programmed to belong to the same class of the sample presented (choose B1 given A1, and B2 given A2). Once at least two sets of conditional relations are established (AB: A1B1 and A2B2; and BC: B1C1 and B2C2), the formation of equivalence classes will be documented if participants are able to respond without any further training to stimuli that were never presented together but were related to a common stimulus (transitivity - AC); if they are able to respond under control of the same stimulus pair when their sample and comparison functions are reversed (symmetry - BA and CB); and if each stimulus that controls participants' responses bear the same trained relation to itself (reflexivity - AA, BB and CC; cf. Sidman & Tailby, 1982; Sidman, 1994).

Stimulus equivalence may offer a behavioral account for a variety of psychological phenomena related to language and creativity (Sidman, 1994) and also has applied implications for the development of behavioral technology for teaching (e.g., de Rose, de Souza, & Hanna, 1996), which makes the conditions necessary for stimulus-class formation a relevant topic of investigation. Among other variables, effects of different stimulus control developed during training (or stimulus control topographies) on the equivalence tests outcomes have been investigated (Dube &

McIlvane, 1996; McIlvane & Dube, 2003). For example, some studies suggest that equivalence is affected by which comparison stimulus conditionally controls participant's responses in the presence of a given sample. In a two-choice MTS arrangement, participants may learn to choose the S+ (or the correct comparison) both by responding under control of the sample and the S+ itself, the so called *select control*, or by responding under control of the sample and the S- (or incorrect comparison), the so called *reject control*. In both cases, S+ is chosen, but different conditional relations are established: sample/S+ relations in the former case and sample/S- relations in the latter (cf. Carrigan & Sidman, 1992; Johnson & Sidman, 1993).

Responding under reject control during training may prevent the programmed equivalence class to form (cf. Carrigan & Sidman, 1992; de Rose, 1996; de Rose, Hidalgo, & Vasconcellos, in press; Johnson & Sidman, 1993; Magnusson, 2002; Perez, 2008; Tomanari, Magnusson, Dube, & Perez, 2012). Carrigan and Sidman (1992) presented a theoretical paper pinpointing how sample/S+ and sample/S- relations might differentially affect participant's performance on equivalence tests. According to their analysis (in a two-choice situation), select control during training leads to the programmed equivalence classes, whereas reject control does not. If during training all conditional discriminations are established via reject control, participants should score next to zero in the transitivity, equivalence and reflexivity tests, although they should score high in the symmetry test. For instance, if during training the participant learns the relations *A1 select B1* and *B1 select C1*, during the transitivity test, when A1 is presented along with C1 and C2, participants may perform *A1 select C1* and C1 will be chosen. In contrast, if during training the participant learns *A1 reject B2* and *B2 reject C1*, participants may perform *A1 reject C1*. In this later case, participants may be "responding away from" C1 by choosing C2, yielding a different (or the opposite) result compared to when select control is established. The same logic can be applied to

equivalence and reflexivity tests. However, in contrast to transitivity, equivalence and reflexivity tests, no difference will be observed in symmetry tests. If the participants learn that given *A1 select B1*, when B1 is presented as sample along with A1 and A2 (symmetry test), the participant may perform the expected *B1 select A1* and, thus, A1 will be chosen. Similarly, if s/he learns *A2 reject B1*, s/he may perform *B1 reject A2*, and A1 may be chosen, as it would happen if select control had taken place (cf. Carrigan & Sidman, 1992; Johnson & Sidman, 1993; Perez & Tomanari, 2008).

Johnson and Sidman (1993) presented experimental data on Carrigan's and Sidman's (1992) analysis. Three adults were exposed to a two-choice MTS task and, after being trained to perform AB/BC/CD conditional relations, they were tested for symmetry (BA, CB and DC), transitivity (AC, BD and AD), equivalence (CA, DB and DA) and reflexivity (AA, BB, CC and DD). Differently from standard equivalence procedures, sample/S- relations were biased during training. In order to do that, a different proportion of S+/S- was used: i.e., each sample and S- (e.g., A1 and B2) were successively presented across trials along with one out of four different S+ (e.g., B1, X1, X2 or X3). By doing that, experimenters assumed that responses would be more likely to occur under the control of one sample/S- (e.g., A1 reject B2) instead of four different sample/S+ conditional relations (A1 select B1, A1 select X1, A1 select X2 and A1 select X3) for each sample that was presented. A delayed cue procedure was also used. After presenting both comparisons, if the participant refrained from responding, the S+ was withdrawn from the screen after a brief interval leaving only the sample and the S- to be observed. Responses to the key where the S+ had been presented were then reinforced. The more correct responses the participant emitted, the longer it would take for the S+ withdrawal. In summary, these were the expected results according to Carrigan and Sidman's analysis (1992): Participants had next to zero correct

responses on transitivity, equivalence and reflexivity and high scores on symmetry (hereafter, *reject-control pattern* during tests for the formation of equivalence classes)⁵

In a systematic replication of Johnson and Sidman's (1993) study, Tomanari, Magnusson, Dube and Perez (2012; based on Magnusson, 2002) established two three-member equivalence classes, one under reject and the other under select control using a single-subject design. When reject control was biased during training, all participants scored next to zero in some of the tests. Nonetheless, only two out of four participants showed a reject-control pattern on tests for the formation of equivalence classes (cf. Carrigan & Sidman, 1992; Johnson & Sidman, 1993). When select control was biased during training, i.e., when four different S- were presented along with each S+ across trials and the delayed cue procedure was programmed for withdrawing the S- from the screen, all participants had high scores in tests for stimulus equivalence (hereafter, a *select-control pattern*). Tomanari et al.'s results suggest that the procedures used were effective to bias select, but not reject, control.

The results described above (Johnson & Sidman, 1993; Tomanari et al., 2012) indicate that both the proportion of S+ and S- used during training and the delayed cue procedure might influence the establishment of select or reject control. Other studies have tried to manipulate such controls by preventing participants from observing one of

⁵ Differences on transitivity and equivalence tests due to select or reject control are modulated by nodal distance (Fields, Verhave, & Farth, 1984). A node is a stimulus that is related to two other stimuli that were not related to each other during training. Opposite results are only expected for tests with stimuli that are separated by an odd number of nodes (e.g., AC, having B as node in a linear training series; or BD, having C as node). When an even number of nodes is involved (e.g., AD, B and C as nodes), no difference on transitivity and equivalence tests are expected. For instance, if during training the participant learns the relations *A1 select B1*, *B1 select C1*, and *C1 select D1*, during the transitivity test, when A1 is presented along with D1 and D2, the participant may perform *A1 select D1* and D1 will be chosen. If *A1 reject B2*, *B2 reject C1*, *C1 reject D2* is learned, the participant may perform *A1 reject D2*, i.e. D1 will be chosen, just like in the former case (cf. Carrigan & Sidman, 1992; Johnson & Sidman, 1993). In the present study, only one-node distance tests will be used.

the comparison stimuli across training sessions (de Rose et al., in press; Goulart, Mendonça, Barros, Galvão, & McIlvane, 2005; Hamasaki, 2009). Some studies (de Rose et al., in press; Goulart et al., 2005) achieved this by fully covering the S+ with a black square along trials in order to bias sample/S- relations or by covering the S- to bias sample/S+ relations. Hamasaki (2009) tried a similar strategy using a MTS task with observing requirements (MTS-OR). In this procedure, all stimuli were hidden behind a window that could be opened by means of a mouse click on a button located right below each stimulus (OR-button). Responses to this button, or observing responses (OR, hereafter), displayed the corresponding stimulus for .2 second. Generally, up to three OR could be emitted for each stimulus; in addition, any comparison could be chosen without the occurrence of any OR, that is, by clicking on the closed window. AB/BC conditional discrimination training was carried out in order to form two three-member equivalence classes. After that, equivalence (CA), symmetry (BA, CB) and transitivity (AC) were tested. During the training phase, participants were divided into two groups that differed by the sample/comparison relation that was biased: sample/S+ (Select-control group) or sample/S- (Reject-control group). Using a three-choice MTS task, Hamasaki (Experiment 2) aimed to bias select or reject control by "locking the window" of one of the S- or of the S+, respectively, in 70% of the training trials. In these trials, OR towards one of the comparison stimuli were under extinction, i.e. did not produce its appearance. Effects on the formation of equivalence classes were evaluated. Select and reject controls were inferred based on the ORs emitted on each trial. Select control was assumed when the S+ was observed and chosen, given the absence of any OR towards S-; conversely, reject control was assumed when both S- were observed and the S+ was chose *without* any OR to it. In the Select-control group, whose participants were prevented from observing one of the S- during training, two out of three participants showed evidence of equivalence class formation. No choice was made without emitting OR toward the S+ and, occasionally,

when the S+ was the first stimulus observed, participants made their choices without emitting OR to any other comparison (S-). The positive results for equivalence class formation and the occurrence of choices after only having observed the S+ suggest the establishment of select control for this group. Conversely, in the reject-control group, whose participants were prevented from observing the S+, all three participants had medium scores during tests for stimulus equivalence. Such negative results for the formation of equivalence classes may suggest that reject control took place during training. Concerning the ORs, however, correct choices made after observing the two S- and not the S+ were absent for all but one subject (in the beginning of the training phase). Since by the end of the training phase no choice was made without OR toward S+, indicatives for the establishment of reject control were weak.

Different variables related to the OR might affect the establishment of sample/S+ or sample/S- relations during training (Hamasaki, 2009). It is possible that the establishment of select or reject control in the MTS-OR procedure might be modulated by the following: a) the number of trials in which participants observe the target comparison for each control, S+ for select or S- for reject control, respectively; and b) the number of trials in which participants are prevented from observing the other available comparison. Extending Hamasaki's (2009) findings, the present study aimed to use the MTS-OR procedure to parametrically evaluate the effects of OR towards comparison stimuli upon the establishment of select or reject control during training. In order to manipulate the number of times that each stimulus was observed, participants had to emit only one OR for each of them and were required to do so before having the option to choose one of the comparisons. In the Reject group, in order to bias sample/S- relations, participants were required to observe sample and S- in every trial; in addition, different sub-groups were prevented from observing the S+ in 25, 50 or 75% of the total trials in a session. In these trials, OR were under extinction. Thus, the mouse-clicking response on the OR-button would not produce the appearance of the

stimulus hidden in that window. In the Select group, in order to bias sample/S+ relations, participants were required to observe the sample and the S+ in every trial and were also prevented from observing the S- in 25, 50 or 75% of the trials.

In Hamasaki (2009), ORs were an independent variable. Participants could observe the same comparison up to three times and could choose a comparison to which no OR had occurred on that trial. In contrast, the present study aimed to strictly manipulate the ORs during training and to evaluate its effects upon the establishment of select and reject controls. Participants were required to emit a single OR toward each comparison before having the chance to choose one of them. Since stimulus observation was experimentally controlled, the occurrence of select or reject controls could not be inferred from participants ORs. As an alternative, equivalence tests were used as a measure of the establishment of select or reject controls (see select- and reject-control patterns, cf. Carrigan & Sidman, 1992; Johnson & Sidman, 1993; Tomanari et al., 2012). Since such patterns can only be inferred when a two-choice MTS task is used, differently from Hamasaki (2009), in the present study two choices were used instead of three during the whole MTS-OR task.

Method

Participants

Thirty undergraduate students aging from 18 to 26 were recruited by means of advertisements on campus. None of them had previous experience with any kind of research in Behavior Analysis. Participants read a term of consent before starting the first experimental session. On this term, they were informed that they could withdraw their participation whenever they wanted to. By the end of the research, participants were debriefed.

Setting, Equipment and Stimuli

Experimental sessions were held in a 2 x 3 m room. Participants were sat on an adjustable task chair in front of a table. On this table a PC, a keyboard, a mouse and two speakers were placed. Stimuli were six colorful-nonsense figures (from Dube & Hiris, 1999) presented on the center of a white background measuring 3.5 x 3.5 cm. A counter (Arial, 16) located on the top-center of the screen, an ascending sequence of notes and a dissonant chord were used as consequences. Software developed in Visual Basic (Perez & Clavijo, 2010) was used to control stimulus presentation, to record participant's responses and program the experimental contingencies.

Experimental Task

Participants were exposed to a two-choice matching-to-sample task with observing requirements (MTS-OR, see Figure 1). In this task, both sample and comparison stimuli were covered by a window (a black square with the same dimensions of the stimuli). In order to observe a given stimulus, participants had to use the mouse cursor to click on a button located immediately below its corresponding window (OR-button). This button was a gray 1 x 2 cm rectangle on which the word "LOOK" was written ("VER" in Portuguese; Arial, 12). Clicking on this button produced the appearance of the stimulus for .3 s. After the stimulus presentation, the black square reappeared, covering the stimulus. Responses on this button will be called observing responses (OR). Participants were allowed to emit only one OR for each stimulus within each trial. Thus, each OR-button was always deactivated once participants clicked on it. Occasionally, as will be described in the next section, OR towards one of the comparisons was under extinction. In these cases, the mouse-clicking response on the OR-button was not followed by the stimulus presentation; in such trials, the black square was not withdrawn and the OR-button was deactivated.

Figure 1. Example of a trial presented on the MTS-OR (matching-to-sample with observing requirements) task. All stimuli are presented behind a "window" that can be opened for .3 s by means of an observing response (OR), i.e. a mouse-click on the OR-button (LOOK). On each trial, only one OR can be emitted to each stimulus. After that its OR-button is deactivated. From the left to the right, each trial starts with the presentation of a sample on the center of the screen. After an OR is emitted to it, two comparison stimuli are immediately presented on the corners. Once ORs are emitted to all stimuli, two buttons are displayed for participants to choose one of the comparisons. In this example, both comparisons were available for observation, i.e. no window was "locked".

Each trial started with the presentation of the sample window in the middle of the screen on a light gray background. After emitting an OR to the sample, the comparison windows were immediately presented. Then, participants had to emit an OR for each comparison in order to proceed. After emitting an OR to both comparisons, two choice buttons appeared immediately below the OR-buttons. Choice buttons had the same dimensions of OR-buttons and had the word "CHOOSE" written on it (in Portuguese, "ESCOLHER").

If the participant clicked on the choice button located below the programmed S+, one point was added to the counter and a sequence of ascending notes sounded. If participants clicked on the choice button located below the programmed S-, no point was added and a dissonant chord sounded. After consequences were presented, a .5 s inter-trial interval (ITI) initiated. During the ITI, all stimulus windows were withdrawn from the screen and only the light gray background and the counter remained.

In each experimental session, each stimulus was presented an equal number of times in each position on the monitor screen. Aside from this, no stimulus was presented more than three consecutive times in the same position. This last criterion was also applied to the presentation of the S+.

Experimental Design

As shown in Table 1, participants were randomly distributed between two groups: Reject (n=15) and Select (n=15), for which reject control (sample/S- relations) and select control (sample/S+ relations) were biased during the training phase, respectively.

In order to bias sample/S- relations (Group Reject) during training, participants were required to observe sample and S- in every trial, and were prevented from observing the S+ in a certain percentage of the training trials. Thus, in these trials, OR to the S+ windows would not produce its appearance, i.e., responses to the OR button

located below the S+ would simply deactivate it without removing the black square that was covering the stimulus (extinction). The trials in which one of the windows was "locked" were randomly assigned. The participants from the Reject group were divided into three sub-groups (R 25, R 50, R 75; n=5) that were differentiated by the percentage (25, 50 and 75%) of trials within the session in which OR toward the S+ window were under extinction (see Table 1).

Table 1. Experimental design. Participants were divided into two groups: Reject and Select. Participants in the Reject group were prevented from observing the S+ in 25, 50 or 75% of the trials in a session, depending on the sub-group to which they were allocated (R 25, R 50 or R 75, respectively). Participants in the Select group were prevented from observing the S- in 25, 50 or 75% of the trials, depending on the sub-group (S 25, S 50 or S 75, respectively).

Group	Sub-group	Percentage of trials in which participants were prevented from observing one of the comparison stimuli during training	
		S+	S-
Reject	R 25	25	0
	R 50	50	0
	R 75	75	0
Select	S 25	0	25
	S 50	0	50
	S 75	0	75

For the Select group, in order to bias sample/S+ relations, participants were required to always observe sample and S+, and were prevented from observing the S-

in a certain percentage of the training trials. Thus, in these trials, OR to the S- windows did not produce the appearance of S-. Similarly to the Reject group, participants from the Select group were also divided into three sub-groups (S 25, S 50, S 75; n=5). In this case, sub-groups were differentiated by the percentage (25, 50 and 75%) of trials in which OR toward the S- window was under extinction (see Table 1).

Procedure

Three sets (A, B and C) of two stimuli (A1 and A2; B1 and B2; C1 and C2) were used during the whole procedure, which was divided into two phases: training (AB/BC) and testing (AC, BA, CB, CA, AA, BB, CC).

Training AB/BC. Before starting the training phase, participants were given the following written instruction (in Portuguese):

"In this task, some figures will be shown on the screen. Nonetheless, all figures will be hidden behind a black square. In order to see the figure that is hidden by a given black square, click on the button "LOOK" placed right below it. Each trial begins with the presentation of a hidden figure in the middle of the screen. After you observe it, two other hidden figures will be presented in the lower corners. After you observe each of them, you will have to make a choice. In order to choose a given figure, click on the button "CHOOSE" placed right below where it was shown. If you make a correct choice, one point will be added to a counter located in the top center of the screen and a sequence of notes will be sounded. If you make an incorrect choice, you won't win any point and a dissonant chord will be sounded. There is one more important thing: sometimes you will not be allowed to see one of the corner figures. Despite not seeing it, you will have to proceed. Your goal is to make as many correct choices as you can. Always try to win points. Have a good game!"

During the AB training, on each trial, a stimulus from Set A (A1 and A2) was presented as sample and stimuli from Set B (B1 and B2) were presented as comparisons. During the BC training, on each trial, a stimulus from Set B (B1 and B2) was presented as sample and stimuli from Set C (C1 and C2) were presented as comparisons. In each training session, each possible trial type was presented four times. The trial types (sample-S+S-) for AB training were A1-B1B2 and A2-B2B1; for BC training, B1-C1C2 and B2-C2C1.

The AB conditional relations were taught first and sessions were comprised of eight trials. BC conditional relations were taught only after achieving the learning criteria to progress with training, which was 100% of correct responses in one session. BC sessions were also comprised of eight trials. Once the criterion was achieved, AB and BC training trials were mixed in a 16-trial AB/BC session and, if participants presented 100% of correct responses, the testing phase began.

Testing equivalence class formation. Before test sessions began, participants were exposed to the following written instructions: "The computer will keep recording your hits and errors but will not give you any feedback. Do your best!"

Test sessions evaluated participants' responses to the following derived relations, in this order: equivalence (CA), symmetry (BA, CB), transitivity (AC) and reflexivity (AA, BB, CC). Participants had one session for each set of derived relations that was tested. Sessions were comprised of 16 baseline-training trials (AB/BC) and 16 test trials. Eight test trials were presented for each of the two tested derived relations, i.e., for each trial type used on that test (e.g., for AC test, eight trials for each trial types: A1-C1C2 and A2-C2C1; for BA test, trial types were B1-A1A2 and B2-A2A1; for CB, C1-B1B2 and C2-B2B1; for CA, C1-A1A2 and C2-A2A1; for AA, A1-A1A2 and A2-A2A1; for BB, B1-B1B2 and B2-B2B1; and finally, for CC, C1-C1C2, C2-C2C1). Participants' responses

during tests, both in baseline and in test trials, were not followed by programmed consequences. Responses were followed only by the ITI, which was the same used in the training phase. Test sessions were not repeated.

Whenever baseline trials were presented, the contingencies applied to the OR were maintained in accordance with the training phase and, thus, were different depending on the group and sub-group in which the participant was allocated (see Table 1). During test trials, both comparisons were observed, i.e., no contingency for the OR was programmed.

Results

All participants met criterion in every step of the training. They took from one to 16 sessions to meet criterion on step AB, from one to 12 sessions on BC and from one to seven sessions on AB/BC. The total number of sessions to finish the whole training phase varied from five to 20.

For most participants during tests, a high accuracy was maintained when baseline-training trials were presented under extinction. Exceptions to this response pattern appeared for two participants from the sub-group S 75 (AS and VA), who presented errors specifically in those trials in which the S- window was locked (i.e., OR to S- under extinction).

Tables 2 and 3 show participants' results during tests both by presenting the number of correct responses in 16 test trials for each session and by classifying the response pattern observed across tests. Taking the symmetry tests as exceptions (BA and CB), the number of correct responses varied widely, from zero to 16, in transitivity (AC), equivalence (CA) and reflexivity tests (AA, BB and CC), especially for the Reject group. Performances during tests were considered in accordance with three different patterns, which were used to infer the establishment of reject or select control during training (cf. Carrigan & Sidman, 1992; Johnson & Sidman, 1993; Tomanari et al.,

2012). A *reject-control pattern* was considered whenever participants emitted no more than one correct response on equivalence (CA), transitivity (AC) and reflexivity (AA, BB and CC) tests, and also emitted at least 15 correct responses in the symmetry (CB and BA) tests (at least 93% of responses in accordance with reject control, cf. Carrigan & Sidman, 1992). A *select-control pattern* was considered whenever participants emitted at least 15 correct responses in the 16 trials of all derived relations that were tested (at least 93% of correct responses in accordance with the programmed equivalence class, i.e., in accordance with select control cf. Carrigan & Sidman, 1992). *Other patterns* were considered whenever participants presented less than 15 correct responses in at least one of the tests and did not show the reject-control pattern. For the Reject group (Table 2), four participants showed reject-control patterns (R 25 DM, R 50 MB, R 75 LM and R 75 MS), two participants showed select-control patterns (R 25 LF and R 50 JU) and nine showed other patterns on equivalence tests. For the Select group (Table 3), nine participants showed select-control patterns (S 25 AB, S 25 IO, S 25 JA, S 50 EL, S 50 EZ, S 50 RC, S 75 AS, S 75 TS, and S 75 VM) and six presented other patterns.

The number of participants in each group that presented each pattern on equivalence tests (reject-control, select-control or other) is also shown in Figure 2. Reject-control patterns during tests were only observed in the Reject group, for four participants. Select-control and other patterns were observed for both groups. Nonetheless, Select-control patterns were much more frequent for the Select group (nine) when compared to the Reject group (two). When considering the pattern obtained during test sessions, no differences were found between sub-groups, except for the sub-group R 75, in which two participants presented reject-control patterns (as opposed to one participant in each R 25 and R 50 sub-groups) and no select-control pattern was observed. Nine participants in the Reject group showed other patterns

during testing. Other patterns were also found for six participants in the Select group, two from each sub-group.

Table 2. The number of correct responses in 16 test trials across each test session is presented for each participant of the Reject group. Results on tests are classified as "Patterns on tests": A *reject-control pattern* was considered whenever participants emitted no more than one correct response on equivalence (CA), transitivity (AC) and reflexivity (AA, BB and CC) tests, and also emitted at least 15 correct responses in the symmetry (CB and BA) tests. A *select-control pattern* was considered whenever participants emitted at least 15 correct responses during all tests. *Other patterns* were considered whenever participants presented less than 15 correct responses in at least one of the tests and did not show the reject-control pattern.

Group	Sub-group	Participant	Number of correct responses in 16 test trials on each test session							Pattern on tests
			CA	CB	BA	AC	AA	BB	CC	
Reject	R 25	DM	1	16	16	0	0	0	0	Reject-control
		LF	16	16	15	16	15	16	16	Select-control
		LR	9	11	16	13	16	16	16	Other
		RS	5	16	13	16	16	15	13	Other
		TM	7	16	2	12	15	16	16	Other
	R 50	BS	9	16	16	14	16	16	15	Other
		CQ	10	14	13	2	1	0	1	Other
		JU	14	16	16	16	16	16	16	Select-control
		MB	0	16	15	0	1	0	0	Reject-control
		MV	2	16	16	7	16	15	16	Other
	R 75	ES	4	10	15	0	0	0	0	Other
		FG	0	16	13	0	15	5	14	Other
		LM	0	16	16	0	0	0	0	Reject-control
		MS	1	15	15	0	0	0	0	Reject-control
		RL	14	11	14	8	0	0	0	Other

Table 3. The number of correct responses in 16 test trials across each test session is presented for each participant of the Select group. Results on tests are classified as "Patterns on tests": A *reject-control pattern* was considered whenever participants emitted no more than one correct response on equivalence (CA), transitivity (AC) and reflexivity (AA, BB and CC) tests, and also emitted at least 15 correct responses in the symmetry (CB and BA) tests. A *select-control pattern* was considered whenever participants emitted at least 15 correct responses during all tests. *Other patterns* were considered whenever participants presented less than 15 correct responses in at least one of the tests and did not show the reject-control pattern.

Group	Sub-group	Participant	Number of correct responses in 16 test trials on each test session							Pattern on tests
			CA	CB	BA	AC	AA	BB	CC	
Select	S 25	AB	16	16	15	15	16	16	16	Select-control
		IO	15	16	16	15	16	16	16	Select-control
		JA	16	15	16	16	16	16	16	Select-control
		MK	7	15	13	1	16	16	16	Other
		SS	4	16	16	7	0	0	1	Other
	S 50	EL	16	16	16	16	16	16	16	Select-control
		EZ	16	16	16	16	16	16	16	Select-control
		GR	8	15	16	16	16	16	16	Other
		MA	13	2	10	7	16	16	16	Other
		RC	15	16	16	16	16	16	16	Select-control
	S 75	AS	16	16	16	16	16	16	16	Select-control
		CO	10	16	13	16	16	16	16	Other
		TS	16	16	15	16	16	16	16	Select-control
		VA	11	16	14	12	1	2	2	Other
		VM	15	16	16	15	16	16	16	Select-control

Figure 2. Number of participants of each group (Reject and Select) showing select-, reject- or other-control patterns during tests.

So far, select and reject controls were inferred from a pattern observed when all tests were taken into account. However, this can also be evaluated whether or not the result obtained in each test, separately, was in accordance with Carrigan & Sidman's (1992) prediction. Considering the result of each test separately, R 50 CQ's scores on reflexivity tests suggest the establishment of reject control. So do the results of three participants from the sub-group R 75: ES had zero score on transitivity and reflexivity tests; FG had zero score on equivalence and transitivity; and RL had zero score on reflexivity. Considering tests separately, a higher number of participants responding in accordance with reject control was found for the sub-group R 75 compared to the sub-groups R 25 and R 50. No differences were observed for any sub-group of the Select group.

Discussion

The present study parametrically evaluated the effects of manipulating the OR towards comparison stimuli upon the establishment of select or reject controls in a MTS-OR task. Participants in the group Reject were required to observe sample and S- in every trial; besides, in different sub-groups, they were prevented from observing the S+ in 25, 50 or 75% of the total trials in a session. Participants in the Select group were required to observe the sample and the S+ in every trial and were prevented from observing the S- in 25, 50 or 75% of the trials. The present results show that it is possible to establish select or reject control by manipulating the observing response toward the comparison stimuli during training. Differences were found between groups that correlate with their observing requirements. Results indicating reject control were more frequent for the group whose participants were required to observe the S- in every trial (Reject); results indicating select control were more frequent for the group whose participants were required to observe the S+ (Select). Considering the sub-group's results on each test, separately, the more the participants from the Reject sub-groups were prevented from observing the S+, the higher was the number of participants performing in accordance with reject control.

The establishment of reject or select control was inferred from patterns observed during tests for the formation of equivalence classes (cf. Carrigan & Sidman, 1992; Johnson & Sidman, 1993; Tomanari et al., 2012). Reject-control patterns were observed for four participants in the Reject group (n=15). Select-control patterns were more frequent for the Select group, although they were found in both groups. No clear differences were observed between sub-groups when the pattern obtained during tests was taken into account. However, considering each test separately, the number of participants whose results indicate reject control according to Carrigan and Sidman's analysis (1992) varied as a function of the number of trials in which they were prevented from observing the S+. Thus, differences were found as a function of a

parametrical manipulation for the Reject group. However, no difference was found comparing sub-groups prevented from observing the S- (Select group).

A characteristic of the MTS procedure itself might account for such asymmetry between the results of sub-groups Reject and Select. For the Select group, the S+ was always available to be observed and the S+ itself had to be chosen. The contingency for the choosing response might have facilitated the control by the S+; besides, since there was no response towards S- but the OR, the likelihood of control by the S- was reduced. Conversely, for the Reject group, the S- was available to be observed in every trial but the S+ had to be chosen; again, this might have increased the chances of control by the S+. According to this analysis, select control would be more likely to be found in both groups when compared to reject control. Consistently, select-control patterns were found for two participants in the Reject group (sub-groups R 25 and R 50), but reject-control patterns were not found for participants in the Select group. Besides, the number of participants responding in accordance with select control in the Select group was higher than the number of participants responding in accordance with reject control in the Reject group, i.e. sample/S- relations seemed more difficult to establish.

A considerable number of participants in both groups showed other patterns during tests. For most of them, from the beginning to the end of the test phase, performances were more likely to be in accordance with that predicted for select or reject control (cf. Carrigan & Sidman, 1992) as sessions were carried out (in Table 2, see participants R 50 CQ, R 75 ES, R 75 RL on the Reject group; in Table 3, see S 25 MK, S 25 SS, S 50 GR, S 75 CO on the Select group). For these participants, a delayed emergence of reject- or select-control patterns should be considered (cf. Dube & McIlvane, 1996; McIlvane & Dube, 2003). That is, such patterns would probably emerge after test repetition (cf. Johnson & Sidman, 1993; Tomanari et al., 2012). However, repeating tests in a two-choice MTS task might not be a reliable option.

During MTS training, participants learn that there is only one correct response among comparisons for each sample that is presented. Unless they emit the correct response, sessions for that training step are continuously repeated. When a perfect performance is achieved, the next experimental phase is initiated. Repeating tests might suggest that participants are responding incorrectly, which may set the occasion for choosing the other available comparison. If that happens, results on equivalence tests cannot be considered a function of the sample/comparison (S+ or S-) relation established during training, but a byproduct of test repetition (for further criticism see also Barnes & Keenan, 1993).

On the other hand, results for some participants in the Reject group who showed other patterns were not indicative for reject control as tests progressed, especially those from the sub-group R 25 (LR, RS and TM). It is possible that when participants were required to observe the S- but were not sufficiently prevented from observing the S+, either select or reject control could be established. That was the case of sub-group R 25, for which the S+ window was "unlocked" in 75% of the trials. As pointed out elsewhere (Carrigan & Sidman, 1992; de Rose et al., in press; Perez & Tomanari, 2008), select- and reject-control patterns during equivalence tests are only expected when each sample/S+ or sample/S- relations are established for every training trial. When select control is established for part of the training trials and reject control is established for another part, results during tests are unpredictable and participants might show other response patterns. Results from participants in the Select group who showed other patterns and no indicative for select control are harder to account for. The systematic exposure to sample and S+ should have increased the chances of equivalence class formation (cf. Carrigan & Sidman, 1992; Sidman, 1987). It is worth considering, in this case, that negative results on equivalence tests are not uncommon in the literature, even when experiments involve the participation of verbally competent adults (e.g., O'Toole, Barnes-Holmes, & Smith, 2007). It is possible that the exposure

to the S- in some of the trials might have set the occasion for reject control to be established.

Although the results of few participants indicate the establishment of reject control, it is worth noticing that two out of five participants from the sub-group R 75 promptly presented reject-control patterns during testing, that is, without test repetition. It is the first time results like these are reported. In previous studies that biased reject control during training (Johnson & Sidman, 1993; Tomanari et al., 2012), reject-control patterns were obtained only after tests were run up to three (Tomanari et al., 2012) or six times (Johnson & Sidman, 1993).

Future studies should continue to investigate how sample/S+ and sample/S- relations can reliably be established. Previous studies combined different procedures such as different proportions of S+/S- and delayed cues (Johnson & Sidman, 1993; Tomanari et al., 2012) or prevented participants from observing one of the comparisons (de Rose et al., in press; Goulart et al., 2005; Hamasaki, 2009) in order to establish select and reject controls. A critical variable that distinguishes the present study from the previous ones (de Rose et al., in press; Goulart et al., 2005; Hamasaki, 2009) is the fact that, in order to bias reject or select control, participants were also required to observe the S- or the S+, respectively, and not only prevented from observing the other available comparison. Other parameters related to the MTS-OR procedure might also affect the establishment of select or reject control. For example, in another experiment, Hamasaki (2009, Experiment 3) showed that the order of appearance of the comparison stimuli might modulate the establishment of select or reject control. Sample/S- relations are more likely to be established when the S- is the first stimulus observed. Similarly, Sample/S+ relations occur more frequently when the first stimulus observed is the S+. In accordance with the literature (Dube et al., 2010; Hamasaki, 2009), the present results suggest the manipulation of observing responses

during training as a stimulus control shaping technique to be considered in future studies.

Other experimental parameters beyond the manipulation of the OR might also modulate the establishment of select or reject control. In Hamasaki (2009), a parameter that might have made reject control less likely to be established was the number of comparisons with S- function simultaneously presented in each trial (Carrigan & Sidman, 1992; de Rose, 1996; Sidman, 1987). In a two-choice MTS task, as used in the present study, select and reject controls are equally likely to be established. However, as the number of comparisons increases, for instance in a three-choice situation (cf. Hamasaki, 2009), reject control becomes less likely to be established. Since on each trial there is only one S+ for a given sample, increasing the number of comparisons also increases the number of S-. While select control requires responses to occur under control of only one sample/S+ relation, responses under reject control require as many sample/S- relations as the number of S- presented along with a given sample (Sidman, 1987).

To conclude, the present experiment is a mimesis of different observing patterns during conditional-discrimination training. It may be considered a simulation of different ways to observe stimuli in a MTS task. As suggested by previous studies that tracked participants eye fixations (e.g., Magnusson 2002; Perez, 2008; Tomanari et al., 2012), results here presented show that different observing patterns during training tended to be followed by different results on equivalence tests, which in turn suggests the establishment of different sample/comparison relations (cf. Carrigan & Sidman; Johnson & Sidman, 1993; Tomanari et al., 2012). In most experiments on equivalence, however, observing responses toward comparison stimuli are not controlled. Thus, failures in the formation of equivalence class in accordance with the programmed contingencies, assumed to be a function of the establishment of sample/S- relations (e.g., Carrigan & Sidman, 1992; de Rose et al., in press; Johnson & Sidman, 1993;

Hamasaki, 2009; Tomanari et al., 2012), might also be correlated with different patterns of observing responses during training. Taking this into account, the MTS-OR procedure should be considered in applied settings as an alternative to increase the coherence between the programmed contingencies and the stimulus control that is established (cf. McIlvane & Dube, 2003).

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CAPÍTULO 3

Effects of Select and Reject Controls on Equivalence Class Formation and Transfer of Function⁶

⁶ Parte desse trabalho foi apresentado em 2012 na X World Conference da Association for Contextual Behavioral Sciences, realizada em Washington, D.C., EUA.

Abstract

The present study used a single-subject design to evaluate the effects of select or reject control upon equivalence class formation and transfer of function. Adults were exposed to a matching-to-sample task with observing requirements (MTS-OR) in order to bias the establishment of sample/S+ (select) or sample/S- (reject) relations. In Experiment 1, four equivalence classes were formed, two under reject (A1B1C1, A2B2C2) and two under select control (D1E2F1, D2E1F2). Participants were tested for transitivity, symmetry and reflexivity; after learning a simple discrimination, they were also tested for transfer of function. Under select control, participants had high scores on equivalence tests; transfer of function was attested for the S+ stimuli programmed to belong to each class. Under reject control, participants had high scores only on the symmetry test; transfer of function was attested to stimuli programmed as S-. In Experiment 2, the equivalence class under reject control was expanded (A1B2C1D2; A2B1C2D1). Participants had high scores only on symmetry and on transitivity and equivalence tests involving two nodes. Transfer of function was extended to the programmed S- added to each class. In Experiment 3, equivalence classes under reject and under select control were joined (A1B2C1D2E2F2; A2B1C2D1E1F1). Transitivity and equivalence tests involving both reject and select relations were carried out (e.g., CE/EC, BE/EB, AF/FA). When tests combined both relations, results varied across participants. Concerning transfer of function, derived functions tended to prevail over those that were directly established.

Keywords: equivalence, transfer of function, select control, reject control, matching-to-sample task with observing requirements, humans.

Effects of Select and Reject Controls on Equivalence Class Formation and Transfer of Function

Once participants learn a certain set of conditional discriminations in a matching-to-sample (MTS) task, the formation of equivalence classes is attested if class-consistent responses occur whenever stimuli from the same class are presented in novel combinations and/or sequences (Sidman, 2000; Sidman & Tailby, 1982; Perez & Tomanari, submitted).

Conditional relations can be taught via MTS task by presenting a given stimulus from one set (A: A1 or A2) as a sample along with stimuli from another set (B: B1 and B2) as comparisons (e.g., AB training). Once sample and comparisons are displayed, the participant has to choose one of the available comparisons. Choosing the comparison programmed to belong to the same class of the sample is reinforced (e.g., choose B1 given A1, and B2 given A2); responses to any other comparison are followed by extinction or punishment. Once conditional relations are learned, transitivity, symmetry and reflexivity tests are carried out in order to confirm the substitutability (or equivalence) of programmed stimulus classes in relation to the control of behavior. The transitivity test (AC) evaluates if the participants respond to stimuli that were never presented together but were related to another stimulus from the same class (B); the symmetry test (BA and CB) requires participants to respond under control of the same stimulus pair when the sample and comparison functions that were trained are reversed; the reflexivity tests (AA, BB and CC) demonstrate whether each stimulus that controls participants responses bear the same trained relation to itself. There is also a combined test, called equivalence test (CA), in which sample and comparisons that were never presented together (transitivity) are displayed having their sample and comparison functions reversed (symmetry) (Sidman, 1994; Sidman & Tailby, 1982).

Different variables might affect the formation of equivalence classes (for a review, see de Rose, 1996; Dube & McIlvane, 1996; McIlvane & Dube, 2003). Among these variables, the comparison that controls participant's responses conditionally to the presence of a given sample might be considered. In a two-choice MTS task, correct responses might occur both under control of sample and comparison programmed as S+ or under control of sample and comparison programmed as S-, the so called select and reject controls, respectively. In both cases, the correct comparison is chosen. Nonetheless, different conditional relations control the choice, sample/S+ relations in the former case and sample/S- relations in the latter (e.g. Dixon & Dixon, 1978; Stromer & Orborne, 1982; Carrigan & Sidman, 1992).

Carrigan and Sidman (1992) theoretically analyzed how select and reject controls might differentially affect results on equivalence tests. If during training the participant learns the relations *A1 select B1* and *B1 select C1*, during the transitivity test, when A1 is presented along with C1 and C2, the participant may perform *A1 select C1*, and C1 will be chosen. Conversely, if during training the participant learns *A1 reject B2* and *B2 reject C1*, the participant may perform *A1 reject C1*, that is, may "respond away from" C1 and chose C2, yielding the opposite result. The same logic can be applied to equivalence (CA) and reflexivity tests (AA, BB, CC). In these tests, different results will also be observed depending on which of these controls was established. However, that is not the case for the symmetry test. If the participant learns *A1 select B1*, when B1 is presented as sample along with A1 and A2 (symmetry test), the participant may perform *B1 select A1*, and A1 will be chosen. The same result will be the case if the relations *A2 reject B1* is learned; during the symmetry test, the participant may perform *B1 reject A2*, and A1 will also be chosen. In summary, Carrigan and Sidman's analysis suggest that if during training all conditional discriminations are established via select control, participants should score high during tests (hereafter, *select-control pattern* during test for equivalence class formation). However, if all conditional relations are

established via reject control, participants should score next to zero in the transitivity, equivalence and reflexivity tests, although they should score high in the symmetry test (hereafter, *reject-control pattern*; cf. Carrigan & Sidman, 1992; Johnson & Sidman, 1993; Perez & Tomanari, 2008; Perez & Tomanari, submitted).

Carrigan and Sidman's analysis set the occasion for studies that investigated the effects of select and reject controls upon equivalence test results (de Rose, Hidalgo, & Vasconcellos, in press; Johnson & Sidman, 1993; Magnusson, 2002; Perez, 2008; Perez & Tomanari, 2011, in preparation; Tomanari, Dube, Magnusson, & Perez, 2012). Johnson and Sidman (1993) exposed three adults to a two-choice MTS task. In the first part of the experiment, they were trained to perform AB/BC conditional relations and, after that, went through symmetry (BA, CB), transitivity (AC), equivalence (CA) and reflexivity tests (AA, BB and CC). Two procedures were combined in order to bias sample/S- relations during training: A different proportion of S+/S- and a delayed-cue procedure. The first procedure consisted of successively presenting each sample and S- (e.g. A1 and B2) along with one out of four different S+ (e.g., B1, X1, X2 or X3). By doing that, experimenters assumed that responses would be more likely to occur under control of one sample/S- (e.g., A1 reject B2) instead of four different sample/S+ conditional relations (A1 select B1, A1 select X1, A1 select X2 and A1 select X3). The second procedure consisted of withdrawing the S+ from the screen after a brief interval if the participant refrained from responding. After the interval, only the sample and the S- were left on the screen and responses to the key where the S+ had been presented were reinforced. The more correct responses the participant emitted, the longer it would take for the S+ withdrawal. In general, participants scored next to zero on transitivity, equivalence and reflexivity and scored high on symmetry. Thus, results confirmed Carrigan and Sidman's analysis (1992).

Tomanari et al. (2012; based on Magnusson, 2002) systematically replicated Johnson and Sidman's (1993) study evaluating the effects of select or reject control

upon equivalence class formation using a single-subject design. Three participants went through two experimental phases: Reject and Select. Both phases were comprised of conditional discrimination training followed by equivalence testing. Different stimulus sets were used in each phase. In the Reject phase, sample/S- relations were biases during training as described in Johnson and Sidman (1993); in the Select phase, sample/S+ relations were biased, i.e. four different S- were presented along with each S+ across trials and the delayed-cue procedure was programmed for withdrawing the S- from the screen. During the Reject phase, all three participants scored next to zero in some of the tests. Two of them eventually showed a reject-control pattern after test repetition (cf. Carrigan & Sidman, 1992; Johnson & Sidman, 1993). When select control was biased during training, all participants had high scores in tests for the formation of equivalence classes (i.e., select-control pattern).

EXPERIMENT 1

According to the studies described above (Carrigan & Sidman, 1992; Johnson & Sidman, 1993; Tomanari et al., 2012), sample/S+ relations lead to formation of equivalence classes that were programmed while sample/S- relations lead to formation of other equivalence classes. When equivalence class-formation under select control is attested, sample and S+ are taken as members of the same class. For example, if during training the participant learns the conditional relations *A1 select B1* and *B1 select C1*, A1, B1 and C1 will comprise the equivalence class A1B1C1. Differently, when equivalence classes are formed under reject control, sample and programmed S- are supposed to belong to the same class. If during training the participant learns *A1 reject B2* and *B2 reject C1*, A1, B2 and C1 should be taken as equivalent to each other forming the class A1B2C1. Although the participation of programmed S- in equivalence

classes is logically plausible, during training and equivalence tests no responses are recorded to such S-.

Further evidence for the participation of the S- in equivalence classes could be found if transfer of function tests were also carried out. Research on transfer of function have shown that once a function is established for one member of an equivalence class the same function is indirectly acquired for other members of that class (e.g. Augustson & Dougher 1997; Barnes & Keenan, 1993; Bortoloti & de Rose, 2009; de Rose, McIlvane, Dube, Galpin, & Stoddard, 1988; Dougher, Augustson, Markham, Greenway, & Wulfert, 1994; Hayes, Kohlenberg, & Hayes, 1991; Valverde, Luciano, & Barnes-Holmes, 2009. For a review, see Dymond & Rehfeldt, 2000; Dougher & Markhan, 1994; 1996). Thus, if any function is established for a given sample, such function should be transferred to the S+ if responses occur under select control or to the S-, if under reject control. The present study investigated this hypothesis by analyzing the transfer of discriminative function in equivalence classes under select or reject control using a single-subject design (cf. Magnusson, 2002; Perez, 2008; Tomanari et al., 2012). Participants were exposed to two experimental phases both comprised of conditional discrimination training, equivalence tests, simple discriminative training and transfer of function tests. Different stimulus sets were used in each phase. On the Reject phase, sample/S- relations were biased during training; on the Select phase, sample/S+. Based on Carrigan and Sidman's analysis (1992), results on equivalence tests were used to infer the control that was establishment. After equivalence-class formation tests, one stimulus of each class was established as discriminative for a response on the keyboard. Then, a transfer of function test was carried out by presenting other stimuli from the same equivalence class and recording participants key-pressing responses.

The first methodological challenge was to manipulate the establishment of sample/S+ or sample/S- relations. In order to bias select or reject control, previous

studies have used different proportions of S+/S- combined with the delayed-cue procedure (Johnson & Sidman, 1993; Tomanari et al., 2012). Recently (Hamasaki, 2009; Perez & Tomanari, submitted), the MTS task with observing requirements (MTS-OR, Hamasaki, 2009) has also been used for the same purpose. In the latter case, all stimuli are hidden behind a window that can be opened by a mouse click on a button located below each stimulus (OR-button). A response to this button, or observing responses (OR), opens the window and displays the corresponding stimulus for .3 s. Using the MTS-OR Perez and Tomanari (submitted) evaluated the effects of manipulating observing responses towards comparison stimuli on the establishment of select or reject controls during training and its effects upon equivalence test results. Participants were divided into two groups: Reject and Select. During training, participants in the Reject group were required to observe sample and S- in every trial; in addition, they were also prevented from observing the S+ in a percentage of the total trials in a session (25, 50 or 75%). In the Select group, participants were required to observe the sample and the S+ in every trial and were prevented from observing the S- in some of the trials. On equivalence tests, reject-control patterns were observed only for participants in the Reject group. Although select-control patterns were found in both groups, they occurred more frequently in the Select group. The results presented by Perez and Tomanari suggest that reject or select control can be biased by manipulating observing responses towards comparison stimuli.

In the delayed-cue procedure (Johnson & Sidman, 1993; Tomanari et al., 2012) the comparison that should not acquire control over responses is withdrawn from the screen (the S+, while biasing reject control; the S-, while biasing select control). However, no observing response is required for the sample and the target comparison of the relation to be established (the S- in the case of reject control; the S+ in the case of select control). Since withdrawing one comparison from the screen might not guarantee that the stimuli that were left will be observed and will exert control over

behavior (Perez & Tomanari, submitted), it was expected that the use of the MTS-OR procedure, instead of the delayed cue, would facilitate shaping sample/S- or sample/S+ relations, especially when combined with different proportions of S+/S- (cf. Johnson & Sidman, 1993; Tomanari et al., 2012).

Method

Participants

Eleven undergraduate students aging from 18 to 30 were recruited by means of advertisements on campus. None of them had previous experience with research in Psychology. Participants read a term of consent with minimal information about the research before the experiment began. In this term, participants were also informed that they could withdraw their consent in participating anytime. By the end of the research, they were fully debriefed concerning the goals of the experiment and procedural issues.

Setting, Equipment and Stimuli

Experimental sessions were held in a 2 x 3 m room. There was an adjustable task chair in front of a table on which a PC, a keyboard, a mouse and two speakers were placed. Stimuli were six colorful-nonsense figures (from Dube & Hiris, 1999) presented on the center of a white background measuring 3.5 x 3.5 cm. An ascending sequence of notes, a dissonant chord and a counter (Arial, 16) located on the top-center of the screen were used as consequences. Software developed in Visual Basic (Perez & Clavijo, 2010) was used to control stimulus presentation, to record participant's responses and to program the experimental contingencies.

Matching-to-Sample with Observing Requirements (MTS-OR)

Participants were exposed to a two-choice matching-to-sample task with observing requirements (cf. Perez & Tomanari, submitted). In this task, a window

completely covered each sample and comparison stimuli. Such window was a black square with the same dimensions of the stimuli (3.5 x 3.5 cm). To observe each stimulus, participants had to place the mouse cursor and click on a button located immediately below its corresponding window (OR-button). This button was a gray 1 x 2 cm rectangle on which the word "LOOK" was written ("VER" in Portuguese; Arial, 12). Clicking on the OR-button produced the appearance of the stimulus for .3 s. After the stimulus presentation, the black square reappeared covering the stimulus. Responses to this button will be called observing responses (OR). Participants were allowed to emit only one OR for each stimulus within each trial. Thus, each OR-button was always deactivated once participants clicked on it. Occasionally, as it will be described in the next section, the OR towards one of the comparisons was under extinction. In these cases, the mouse-clicking response on the OR-button was not followed by the stimulus presentation; in such trials, the black square was not withdrawn and the OR-button was deactivated.

Each trial started with the presentation of the sample window in the middle of the screen on a light-gray background. After emitting an OR to the sample, the comparison windows were immediately presented. In order to proceed, participants had to emit an OR for each comparison. After that, two choice buttons appeared immediately below the OR-buttons of each comparison. Choice buttons had the same dimensions of OR-buttons and had the word "CHOOSE" written on it (in Portuguese, "ESCOLHER"). If a mouse-click response occurred on the choice button located below the programmed S+, one point was added to the counter and a sequence of ascending notes sounded. If a mouse-click occurred on the choice button located below the programmed S-, no point was added and a dissonant chord sounded. The deliver of consequences was followed by a .5 s inter-trial interval (ITI). During the ITI, only the counter remained on the screen; all stimulus windows were withdrawn.

Within an experimental session, each stimulus was presented an equal number of times in each position and no stimulus was presented more than three consecutive times in the same position on the monitor screen. This last criterion was also applied to the presentation of the S+.

Procedure

Two experimental phases were programmed: Reject and Select. As displayed in Figure 1, during the Reject phase, sample/S- relations were biased during training; during the Select phase, sample/S+. Each experimental phase was comprised of conditional discrimination training, equivalence tests, simple discrimination training and transfer of function test. In each phase, three different sets of two stimuli were used. During the Reject phase, stimuli sets were A (A1, A2), B (B1, B2) and C (C1, C2); during the Select phase, D (D1, D2), E (E1, E2) and F (F1, F2).

Figure 1. Reject (left portion) and Select phase (right portion) conditional discrimination training (upper portion) and equivalence test (lower portion). A circles or a diamond on

the end of each solid line indicates that reject or select control was biased during training, respectively. Dashed lines indicate derived relations that were tested. Black and grey colors differentiated equivalence classes expected to be established.

Participants went through both experimental phases and were randomly assigned to start from the Reject or the Select phase. For six participants (ACH, JPH, PSG, GCC, JMG, RFP), the experiment began with the Reject phase. Once it was completed, participant moved to the Select phase; for five participants (GMD, RS, GP, MMM, DFG) the order of the experimental phases was reversed.

Biasing procedures. During the Reject phase, in order to bias sample/S- relations, participants were required to observe sample and S- in every trial and were prevented from observing the S+ in 50% of the training trials. In these trials, OR to the S+ windows would not produce its appearance, i.e., responses to the OR-button located below the S+ would deactivate it without removing the black square that was covering the S+ stimulus (extinction). During the Select phase, in order to bias sample/S+ relations, participants were required to always observe sample and S+ and were prevented from observing the S- in 50% of the training trials. Thus, in these trials, OR to the S- windows did not produce its appearance. Such trials, in which one of the windows was "locked", were randomly assigned across the session (cf. Perez & Tomanari, submitted).

In addition to the manipulation of the observing responses, different proportions of S+/S- were also used as biasing procedure (cf. Carrigan & Sidman, 1992; Johnson & Sidman, 1993; Tomanari et al., 2012). As presented in Table 1, during the Reject phase, each sample and S- (e.g. A1 and B2) were successively presented across trials along with one out of three different S+ (e.g., B1, X1, or X3), forming three different trial types (A1-B1B2; A1-X1B2; A1-X3B2). The rationale for this procedure relies on the assumption that in order to master criterion it would be more likely for participants to

learn one sample/S- relation instead of three sample/S+ relations, and, therefore, the former would prevail. Conversely, during Select phase, each sample and S+ (e.g. D1 and E1) were successively presented across trials along with one out of three different S- (e.g., E2, W1, or W3), forming three different trial types (D1-E1E2; D1-E1W1; D1-E1W3). In this case, sample/S+ relations would prevail (cf. Carrigan & Sidman, 1992; Johnson & Sidman, 1993; Tomanari et al., 2012).

Reject-phase training. Before starting the training phase, participants were given the following written instruction (in Portuguese):

"In this task, some figures will be shown on the screen. Nonetheless, all figures will be hidden behind a black square. In order to see the figure that is hidden by a given black square, click on the button "LOOK" placed right below it. Each trial begins with the presentation of a hidden figure in the middle of the screen. After you observe it, two other hidden figures will be presented in the lower corners. After you observe each of them, you will have to make a choice. In order to choose a given figure, click on the button "CHOOSE" placed right below where it was shown. If you make a correct choice, one point will be added to a counter located in the top center of the screen and a sequence of notes will be sounded. If you make an incorrect choice, you won't win any point and a dissonant chord will be sounded. There is one more important thing: sometimes you will not be allowed to see one of the corner figures. Despite of not seeing it, you will have to proceed. Your goal is to make as many correct choices as you can. Always try to win points. Have a good game!"

The Reject-phase training started with AB conditional relations. In each AB-training trial, a stimulus from Set A (A1 or A2) was presented as sample; both stimuli from Set B (B1 and B2) or one stimulus from Set B and another from an extra set (X:

X1, X2, X3 and X4 - see Table 1 in biasing procedure section) were presented as comparisons. AB training sessions were comprised of 24 trials. Each trial type was presented four times (see upper right portion of Table 1). In half of each trial type presentations, OR towards the S+ were under extinction (see biasing procedure section). In these trials, only sample and S- were observed. The learning criterion to progress with training was no more than one incorrect response in one session. If criterion was not reached, sessions were repeated with a novel randomized sequence of trials. Once participant met criterion the next training step was initiated. After AB training, BC conditional relations were taught. On each BC-training trial, a stimulus from Set B (B1 or B2) was presented as sample; both stimuli from Set C (C1 and C2) or one stimulus from Set C and another from an extra set (Y: Y1, Y2, Y3 and Y4 - see Table 1) were presented as comparisons. Sessions parameters were the same described for AB sessions. After BC training, one AB- and one BC-training session were mixed into a 48-trial AB/BC session. Once criterion was achieved, another AB/BC session was ran without feedback (extinction) in order to prepare participants for test sessions.

Reject-phase equivalence tests. Before test sessions began, participants were exposed to the following written instructions: "The computer will keep recording your hits and errors but will not give you any feedback. Do your best!"

Test sessions evaluated participants' responses to the following derived relations, in this order: transitivity (AC), symmetry (BA, CB), equivalence (CA) and reflexivity (AA, BB, CC). Participants had at least one session for each set of derived relations that was tested. Sessions were comprised of 16 baseline (AB/BC) trials and 16 test trials. Eight test trials were presented for each trial type, i.e. for each of the two derived relations that were tested in each session (e.g., for AC test, trial types were: A1-C1C2 and A2-C2C1; for BA, B1-C1C2 and B2-C2C1; for CB, C1-B1B2 and C2-B2B1; for CA, C1-A1A2 and C2-A2A1; for AA, A1-A1A2 and A2-A2A1; for BB, B1-B1B2 and B2-

B2B1; and finally, for CC, C1-C1C2, C2-C2C1). Participants' responses during tests were not followed by programmed consequences, but only by the ITI.

During test sessions, whenever baseline trials were presented, the contingencies applied to the OR were maintained in accordance with the training phase. During test trials, both comparisons were observed.

Table 1. Biasing procedure: different proportions of S+/S-. The right column presents the trial types that were used to bias reject or select control depending on the trained relations of each experimental phase.

Experimental Phase	Training step	Trained relation	Trial types		
Reject	AB	A1 reject B2	A1- <u>B1</u> B2	A1- <u>X1</u> B2	A1- <u>X3</u> B2
		A2 reject B1	A2- <u>B2</u> B1	A2- <u>X2</u> B1	A2- <u>X4</u> B1
	BC	B1 reject C2	B1- <u>C1</u> C2	B1- <u>Y1</u> C2	B1- <u>Y3</u> C2
		B2 reject C1	B2- <u>C2</u> C1	B2- <u>Y2</u> C1	B2- <u>Y4</u> C1
Select	DE	D1 select E1	D1- <u>E1</u> E2	D1- <u>E1</u> W1	D1- <u>E1</u> W3
		D2 select E2	D2- <u>E2</u> E1	D2- <u>E2</u> W2	D2- <u>E2</u> W4
	EF	E1 select F1	E1- <u>F1</u> F2	E1- <u>F1</u> Z1	E1- <u>F1</u> Z3
		E2 select F2	E2- <u>F2</u> F1	E2- <u>F2</u> Z2	E2- <u>F2</u> Z4

Reject-phase simple discrimination training. Once conditional discrimination training and equivalence tests were over, A1 and A2 were established as discriminative stimulus for specific responses on the keyboard. Before starting the simple discrimination training session, participants were given the following written instruction: "A figure will be presented in the middle of the screen. You must press A or L. If you press the correct key for that figure, one point will be added to a counter located in the upper-center portion of the screen and a sequence of ascending notes will sound. If

you press the incorrect key, you will not win any point and a dissonant chord will sound".

During this phase, a trial began with a stimulus from set A (A1 or A2) displayed on the center of the screen. Given the stimulus presentation, participants had to press the key A or L on the keyboard. A single press to one of those keys was followed by programmed consequences for correct or incorrect responses. The consequences were the same used during the MTO-OR task. Responses to other keys did not produce any consequence. After delivering consequences, an ITI of .5 s was initiated and a new trial was loaded. Whenever A1 was presented, a response to key A was considered correct and a response to key L was considered incorrect. Whenever A2 was presented, contingencies were reversed, i.e., responses to key L were considered correct and responses to key A were considered incorrect. A session was comprised of 20 trials, 10 trials for each stimulus, A1 and A2. Stimuli were randomly presented. Training sessions ended when the learning criterion was achieved (the same used for conditional discrimination training). After that, the transfer-of-function test was initiated.

Reject-phase transfer-of-function test. Before the test session started, participants were given the same written instruction presented before equivalence testing. During the transfer-of-function test, all stimuli from sets A, B and C were presented across trials and responses to keys A or L were recorded. A test session was comprised of 60 trials. During this session, each stimulus from each set (A1, A2, B1, B2, C1 and C2) was randomly presented for 10 trials. Participant's responses were not followed by programmed consequences but the ITI.

Select-phase training. The same guidelines described for the Reject phase were applied to the Select phase. Hereafter, it will be described what differed one phase from the other. Select-phase training started with DE conditional relations. On each

DE-training trial a stimulus from Set D (D1 or D2) was presented as sample; both stimuli from Set E (E1 and E2) or one stimulus from Set E and another from an extra set (W: W1, W2, W3 and W4 - see Table 1) were presented as comparisons. In half of each trial type presentation, ORs towards the S- were under extinction. In these trials, only sample and S+ were observed. Once the learning criterion was achieved for DE training, EF conditional relations were taught. On each EF-training trial a stimulus from Set E (E1 or E2) was presented as sample; both stimuli from Set F (F1 and F2) or one stimulus from Set F and another from an extra set (Z: Z1, Z2, Z3 and Z4 - see Table 1) were presented as comparisons. After EF training, one DE- and one EF-training session were mixed in a 48-trial DE/EF session. Once criterion was achieved another EF/EF session was ran without feedback (extinction).

Select-phase equivalence tests. Test sessions evaluated participants' responses to the following derived relations, in this order: transitivity (DF), symmetry (ED, FE), equivalence (FD) and reflexivity (DD, EE, FF). Test trial types were: for DF test, D1-F1F2 and D2-F2F1; for ED, E1-D1D2 and E2-D2D1; for FE, F1-E1E2 and F2-E2E1; for FD, F1-D1D2 and F2-D2D1; for DD, D1-D1D2 and D2-D2D1; for EE, E1-E1E2 and E2-E2E1; and finally, for FF, F1-F1F2, F2-F2F1).

Select-phase simple-discrimination training and transfer-of-function test. During the simple discrimination training, D1 and D2 were displayed across trials. Whenever D1 was presented, a response to key A was considered correct and a response to key L was considered incorrect. Whenever D2 was presented, contingencies were reversed. During the transfer-of-function test, all stimuli from sets, D, E and F were presented across trials and responses to keys A or L were recorded.

Results

Reject Phase

All participants went through the whole Reject-phase training. They took from two to nine sessions to met criterion on AB training, from one to four sessions on BC and from one to four sessions on AB/BC. For most participants performance was maintained on AB/BC session without feedback. For two of them (PSG and GP) AB/BC training had to be repeated and performance was kept stable on the second session without feedback. For participant JMG, AB/BC baseline relations deteriorated on the first test session and, thus, AB/BC training was repeated. The total number of training sessions varied from seven to 14 across participants.

Participants' results during Reject-phase equivalence tests are displayed on Table 2. It shows the number of correct responses in 16 test trials for each session and also classifies the response pattern obtained during tests according to Carrigan and Sidman's analysis (1992). All participants had high scores on symmetry tests (BA and CB), exception made for JMG on BA test. On transitivity (AC), equivalence (CA) and reflexivity tests (AA, BB and CC), the number of correct responses varied widely across participants, ranging from zero to 16. Performances during tests were classified in accordance with three different patterns used to infer the establishment of reject or select control during training (cf. Carrigan & Sidman, 1992; Johnson & Sidman, 1993; Tomanari et al., 2012; Perez & Tomanari, submitted). A *reject-control pattern* was considered whenever participants emitted no more than one correct response on equivalence (CA), transitivity (AC) and reflexivity (AA, BB and CC) tests, and also emitted at least 15 correct responses in the symmetry (CB and BA) tests (at least 93% of responses, cf. Carrigan & Sidman, 1992). A *select-control pattern* was considered whenever participants emitted at least 15 correct responses in the 16 trials of all derived relations that were tested (at least 93% of correct responses in accordance with the programmed equivalence class). *Other patterns* were considered whenever

participants presented less than 15 correct responses in at least one of the tests and did not show the reject-control pattern. Seven participants showed reject-control pattern (ACH, JPH, PSGM GCC, GMD, RS and GP), one showed select-control pattern (MMM) and three showed other patterns (JMG, RFP and DFG) on equivalence tests. Occasionally, some tests were repeated but never more than twice, exception made for DFG.

Table 2. Participants' results on Reject phase equivalence tests. It is presented the number of correct responses in 16 test trials during each test session. The pattern obtained during tests were classified as: 1) reject control, when low scores on transitivity, equivalence and reflexivity, and high scores on symmetry were found; 2) select control, when high scores were obtained in all tests; and 3) other, when neither reject nor select control patterns were found.

Participant	Order of Exp. Phases	Reject phase equivalence tests Correct responses in 16 test trials							Pattern on tests
		AC	BA	CB	CA	AA	BB	CC	
ACH	R-S	0	16	15	0	0	0	0	Reject control
JPH	R-S	0*	15	16	0	1	0	0	Reject control
PSG	R-S	0*	16*	16	0	0	1	0	Reject control
GCC	R-S	0	16	16	0	0*	0	0	Reject control
JMG	R-S	6*	13*	15	3	4	1	1	Other
RFP	R	13	15	16	16	16	15	16	Other
GMD	S-R	0*	15*	16	1	0	0	0	Reject control
RS	S-R	0	15*	15	0	1	0	1	Reject control
GP	S-R	5*	16*	15	0	0	1	0	Reject control
MMM	S-R	16*	16	16	15	16	16	16	Select control
DFG	S-R	0**	16	16	2**	16	16	16	Other

*Note: Each * indicates one test repetition.

Table 3 presents the results from the Reject phase simple-discrimination training and transfer-of-function test. Participants took from one to three sessions to achieve criterion on the discriminative training. Results during tests were classified according to predictions for equivalence class formation under reject or select control (cf. Carrigan & Sidman, 1992; Johnson & Sidman, 1993). Equivalence class formation under reject control is assumed when the following conditional relations are likely to be the case: A1 reject B2 / B2 reject C1 and A2 reject B1 / B1 reject C2 (see Figure 1). In such case, is also considered that the following equivalence classes are formed: A1B2C1 and A2B1C2 (cf. Johnson & Sidman, 1993). Taking this into account, whenever key-A pressing occurred in at least 9 out of 10 trials given the presentation of A1, B2 and C1, and key-L pressing occurred in at least 9 out of 10 trials given the presentation A2, B1 and C2, a result in accordance with reject-control establishment was considered on transfer-of-function tests. On the other hand, equivalence class formation under select control is assumed when the following conditional relations are likely to be the case: A1 select B1 / B1 select C1 and A2 select B2 / B2 select C2 (see Figure 1). When it happens, the following equivalence class formation is considered: A1B1C1 and A2B2C2. Taking this into account, the establishment of select control was assumed whenever key-A pressing occurred in at least 9 out of 10 trials given the presentation of A1, B1 and C1, and key-L pressing occurred in at least 9 out of 10 trials given the presentation A2, B2 and C2. When both key-pressing responses occurred to the same stimulus (e.g., given B1, 8 presses on key A and 2 presses on key L), no result was displayed on Key A and Key L columns and transfer of function was not considered. Considering the criterion described above, five participants responded in accordance with reject control (ACH, JPH, PSG, GMD and RS) and two responded in accordance with select control (RFP and MMM). Four participants distributed responses between keys when B and/or C stimuli were presented (GCC, JMG, GP and DFM). Tests were not repeated, exception made for participants RS.

Table 3. Participants' results on Reject phase simple-discrimination training and transfer-of-function tests. When responses to keys A or L occurred in 90% of the trials in which a given stimulus was presented, the alphanumeric signature of that stimulus was displayed below the respective key-pressing response. When both responses occurred for the same stimulus, no signature was displayed. When Key-A or Key-L responses occurred to stimuli related under reject control, results were classified as reject control; responses occurred to stimuli related under select control, results were classified as select control. When the same response occurred for stimuli that were not programmed to belong to the same class, responses were classified as "other".

Participant	Number of training sessions	Reject phase transfer of function test							Pattern on tests
		Stimulus that controlled key pressing in at least 9 out of 10 trials							
		Key A			Key L				
ACH	1	A1	B2	C1	A2	B1	C2	Reject control	
JPH	1	A1	B2	C1	A2	B1	C2	Reject control	
PSG	1	A1	B2	C1	A2	B1	C2	Reject control	
GCC	1	A1			A2			Other	
JMG	1	A1	B1		A2		C2	Other	
RFP	1	A1	B1	C1	A2	B2	C2	Select control	
GMD	2	A1	B2	C1	A2	B1	C2	Reject control	
RS	2	A1	B2	C1	A2	B1	C2	Reject control*	
GP	3	A1		C1	A2			Other	
MMM	2	A1	B1	C1	A2	B2	C2	Select control	
DFG	1	A1	B2		A2	B1	C1 C2	Other	

*Note: Each * indicates one test repetition.

Select Phase

All participants went through the whole Select-phase training. They took from 3 to 6 sessions to met criterion on DE training, no more than 2 sessions on EF, from 1 to 9 sessions on DE/EF, and only 1 session on DE/EF under extinction. The total number of sessions to complete training varied from 5 to 14. Participant RFP, who participated on the Reject phase, quit the experiment before the Select phase began.

Participants' results during Select phase equivalence tests are displayed on Table 4. All participants had high scores during all tests and performances were taken as indicative of select-control establishment during training. The only exception was GP. He had medium scores on test ED and FD and neither select nor reject control could be inferred from equivalence-class formation tests. In general, test repetition was rare and did not occur more than once, exception made for JMG and GP, who had a test session repeated twice.

Table 5 presents the results from the Select phase simple-discrimination training and transfer-of-function test. Participants took from 1 to 3 sessions to achieve criterion on the discriminative training. Eight participants responded in accordance with select control (ACH, JPH, PSG, JMG, GMD, GP, MMM, and DFG) and none responded in accordance with reject control. Two participants distributed responses between keys when B and/or C stimuli were presented (GCC and RS). In general, there was no test repetition, exception made for participant RS.

Table 4. Participants' results on Select phase equivalence tests. It is presented the number of correct responses in 16 test trials during each test session. The pattern obtained during tests were classified as: 1) reject control, when low scores on transitivity, equivalence and reflexivity, and high scores on symmetry were found; 2) select control, when high scores were obtained in all tests; and 3) other, when neither reject nor select control patterns were found.

Participant	Order of Exp. Phases	Select phase equivalence tests							Pattern on tests
		Correct responses in 16 test trials							
		DF	ED	FE	FD	DD	EE	FF	
ACH	R-S	16	15	15	15	16	16	16	Select control
JPH	R-S	16	16	16	16	16	16	16	Select control
PSG	R-S	16	16	16	16	16	16*	16	Select control
GCC	R-S	16*	16	16*	16	16	16	16	Select control
JMG	R-S	16*	16	16	16	16**	16*	16	Select control
GMD	S-R	15	16	16	16	16	16	16	Select control
RS	S-R	15	14	16	14	16	15	16	Select control
GP	S-R	16*	13**	15	9	16*	16	16	Other
MMM	S-R	16	16	16	16	16	16	16	Select control
DFG	S-R	16	16	16	15	16	16	16	Select control

*Note: Each * indicates one test repetition.

Table 5. Participants' results on Select phase simple-discrimination training and transfer-of-function tests. When responses to keys A or L occurred in 90% of the trials in which a given stimulus was presented, the alphanumerical signature of that stimulus was displayed below the respective key-pressing response. When both responses occurred for the same stimulus, no signature was displayed. When Key-A or Key-L responses occurred to stimuli related under reject control, results were classified as reject control; responses occurred to stimuli related under select control, results were classified as select control. When the same response occurred for stimuli that were not programmed to belong to the same class, responses were classified as "other".

Participant	Number of training sessions	Select phase transfer of function test							Pattern on test
		Stimulus that controlled key pressing in at least 9 out of 10 trials							
		Key A			Key A				
ACH	1	A1	B1	C1	A2	B2	C2	Select control	
JPH	1	A1	B1	C1	A2	B2	C2	Select control	
PSG	1	A1	B1	C1	A2	B2	C2	Select control	
GCC	1	A1	B1		A2			Other	
JMG	1	A1	B1	C1	A2	B2	C2	Select control	
GMD	1	A1	B1	C1	A2	B2	C2	Select control	
RS	1	A1	B2	C2	A2	B1	C1	Other*	
GP	2	A1	B1	C1	A2	B2	C2	Select control	
MMM	1	A1	B1	C1	A2	B2	C2	Select control	
DFG	1	A1	B1	C1	A2	B2	C2	Select control	

*Note: Each * indicates one test repetition.

Discussion

Experiment 1 evaluated the transfer of discriminative function in equivalence classes under select or reject control. Participants were exposed to two experimental

phases comprised of conditional discrimination training, equivalence tests, simple discriminative training and transfer of function tests. On the Reject phase, sample/S- relations were biased during training; on the Select phase, sample/S+.

In both phases, all participants completed training and went through equivalence-class formation tests. Seven out of 11 participants showed reject-control pattern during the Reject phase and nine out of 10 showed select-control pattern during Select phase. Results on such tests corroborate the analysis presented by Carrigan and Sidman (1992), i.e. under reject control most participants scored next to zero on transitivity, equivalence and reflexivity tests and scored high on symmetry; under select control, most participants scored high in all tests.

Johnson and Sidman (1993) presented data showing reject-control pattern during equivalence-class formation tests as previewed by Carrigan and Sidman (1992). Perez and Tomanari (submitted) showed equivalence tests results varying as a function of select or reject control biasing procedures using a group design and so did Tomanari et al. (2012, based on Magnusson, 2002) using a single-subject design (see also Perez, 2008). In most of these studies, no more than four participants were used (Johnson & Sidman, 1993; Tomanari et al., 2012; Perez, 2008). In Perez and Tomanari (submitted), 15 participants were assigned for the Reject group; however, only four of them showed reject-control pattern during tests. The present study used a single subject design and systematically replicated previous finds with a larger number of participants showing reject- and select-control patterns during tests for the formation of equivalence classes. Reject- and select-control patterns were replicated across conditions and across subjects. These results suggest that patterns observed on equivalence tests are a reliable measure for select- and reject-control establishment.

In previous studies that used different proportions of S+/S- and delayed cue as biasing procedures, select- or reject-control patterns were found only after tests were repeated up to three (Johnson & Sidman, 1993) or six times (Tomanari et al., 2012).

Using the MTS-OR procedure to manipulate the observing responses towards comparison stimuli, Perez and Tomanari (submitted) found such patterns without repeating tests. In the present study, test repetitions were rare. In addition to it, select or reject control was established for most participants during the phase in which it was biased. These results suggest that the combination of different proportions of S+/S- and the MTS-OR procedure was effective in shaping sample/S- and sample/S+ relations and should be considered in future studies investigating these topics.

The order of experimental phases had little impact upon the establishment of select or reject control. However, a few exceptions should be considered for participants that started from the Select phase. Participant GP was the only participant who did not show select-control patterns on the Select phase. However, when exposed to the Reject phase, he showed reject control pattern during tests. This result differs from previous data suggesting that reject control is more difficult to obtain when compared to select control (cf. Perez & Tomanari, submitted; Tomanari et al., 2012; Perez, 2008). Concerning participant MMM, after exposed to the Select phase he also responded under select control during the Reject phase. It suggests that sample/S+ relations are not unlikely to be established even when sample/S- relations are biased. In spite of any reject-control-biasing procedure, in a MTS task the S+ must always be chosen. This might increase the likelihood of select control even when the participant has to learn a higher number of sample/S+ relations to meet criterion (for further discussion, Perez & Tomanari, submitted).

Four participants showed other patterns on equivalence-class formation tests. However, if tests are considered separately, JMG responded in accordance with reject control during BB and CC reflexivity tests; so did DFG on tests AC, BA, CB and CA. RFP responded in accordance with select control in all tests but AC. So did GP, except in tests ED and FD. It is possible that if tests were repeated (cf. Johnson & Sidman, 1993; Tomanari et al., 2012), select- or reject-control patterns would eventually

emerge. However, we preferred to avoid extensive test repetitions. Since in previous steps of the experiment sessions were repeated when the learning criterion was not met, repeating test sessions could suggest that the participant was responding incorrectly (for further discussion on this topic, see Barnes & Keenan, 1993; Dymond & Rehfeldt, 2000; Perez & Tomanari, submitted).

Experiment 1 also aimed to evaluate whether different equivalence classes would be formed under reject or select control. In order to do that, a discriminative function was established for one stimuli of each class and transfer of function was tested. Five out of seven participants who showed a reject-control pattern on equivalence tests presented transfer of function results suggesting the participation of programmed S+ and S- in equivalence classes, A1B2C1 and A2B2C1. Note that the term *programmed* is used. In fact, A1 B2 and C1 were all S+ for pressing A, and so were A2, B1 and C2 for pressing L. Eight out of nine participants who showed select-control pattern during the Select phase presented results suggesting that classes were formed only by stimuli programmed as S+, D1E1F1 and D2E2F2. These results corroborate the suggestion that the establishment of sample/S+ or sample/S- relations may yield the formation of different equivalence classes (cf. Carrigan & Sidman, 1992; Johnson & Sidman, 1993).

One participant that did not show equivalence class formation demonstrated transfer of function (GP, phase Select). Similar findings were found in previous studies (e.g., Barnes-Holmes, Keane, Barnes-Holmes, & Smeets, 2000). Conversely, two participants that showed equivalence-class formation in accordance with reject control had no indicative of transfer of function. The latter case also goes along with the literature showing that participants who respond in accordance with the formation of equivalence classes do not necessarily demonstrate transfer of function (e.g., Dougher et al., 1994; Hayes et al., 1991). This result suggests that different variables might affect behavior on equivalence and transfer-of-function tests, i.e. they might reflect different processes (see Dougher & Markham, 1994, 1996). The reasons for that are

still unclear and further investigation is needed (cf. Dymond & Rehfeldt, 2000; Dougher & Markhan, 1994; 1996; Greenway, Dougher & Wulfert, 1996).

In the present experiment, transfer-of-function tests were used in order to pinpoint which stimuli belong to each equivalence class. Test results suggest that under reject control comparisons programmed as S+ and as S- were members of the same equivalence class; under select control, equivalence classes were formed only by stimuli programmed as S+. Although the transfer of function via S- relations has already been reported (see Barnes & Keenan, 1993), this is the first study that shows *programmed* S+ and S- acquiring the same function due to participation in equivalence classes. Experiment 2 aimed to extend these findings by expanding equivalence classes. That allowed evaluating the effects of class expansion upon reject- and select-control patterns during equivalence-class formation and transfer-of-function tests (cf. Carrigan & Sidman, 1992; Johnson & Sidman, 1993).

EXPERIMENT 2

According to Carrigan and Sidman's analysis (1992), differences on transitivity and equivalence tests due to select or reject control are modulated by nodal distance (Fields, Verhave, & Farth, 1984). A node is a stimulus that is related to two other stimuli that were not related to each other during training. Opposite results are only expected for tests with stimuli involved in a reject-controlling relation separated by an odd number of nodes (e.g., AC, having B as node in a linear series; or BD, having C as node). When an even number of nodes is involved (e.g., AD, B and C as nodes), no difference on transitivity and equivalence tests are expected. For instance, if during training the participant learns the relations *A1 select B1*, *B1 select C1*, and *C1 select D1*, during the transitivity test, when A1 is presented along with D1 and D2, the participant may perform *A1 select D1* and D1 will be chosen. If *A1 reject B2*, *B2 reject C1*, *C1 reject D2* is learned, the participant may perform *A1 reject D2*, i.e. D1 will be

chosen, just like in the former case (cf. Carrigan & Sidman, 1992; Johnson & Sidman, 1993).

In another part of Johnson and Sidman's study (1993), once participants were trained on AB/BC conditional relations and equivalence tests were ran, equivalence classes were expanded to four members. After performing AB/BC/CD conditional relations, the following tests were carried out: symmetry (DC), transitivity involving one (AC, BD) and two nodes (AD), equivalence involving one (CA, DB) and two nodes (DA) and reflexivity (AA, BB, CC, DD). Results confirmed Carrigan and Sidman's analysis (1992). In general, participants scored next to zero on one-node transitivity and equivalence test and scored high on two-node tests. Besides, as in the first part of the experiment, participants scored high on symmetry and next to zero on reflexivity tests.

Experiment 2 aimed to systematically replicate the second part of Johnson and Sidman's (1993) study by including set D on ABC equivalence classes under reject control. The addition of set D, and not of a novel set, allowed not only evaluating the effects of nodal distance upon transitivity and reflexivity tests, but also evaluating whether results on DD-reflexivity tests would change given the context of CD-reject-control training. In addition to it, after equivalence-class formation tests were carried out, the simple discriminative training involving set A was reviewed and the transfer-of-function test was repeated including D-stimulus set. The addition of such extra set allowed replicating the finding of programmed S- acquiring the same function of programmed S+ due to participation in equivalence classes, now having two S+ and two S- in each class.

Method

Participants

Participants that showed reject-control patterns during the Reject phase and also select-control patterns during the Select phase were assigned for Experiment 2: ACH, JPH, PSG, GCC, GMD and RS.

Setting, Equipment, Stimuli, Experimental Task and Biasing Procedures

The same described for Experiment 1.

Procedure

A general scheme of Experiment 2 is presented on Figure 2. It started with CD conditional discrimination training under reject control, followed by a review of AB/BC training session. After achieving criterion, an AB/BC/CD session was run. When participant's performance on AB/BC/CD conditional relations were maintained on a session without feedback, equivalence tests took place and were followed by a simple-discrimination-training review and transfer-of-function tests including A, B, C and D stimuli. In general, the same guidelines described for Experiment 1 were followed.

CD reject training. On each CD-training trial, a stimulus from Set C (C1 or C2) was presented as sample; both stimuli from Set D (D1 and D2) or one stimulus from Set D and another from an extra set (V: V1, V2, V3 and V4) were presented as comparisons. Trial types were C1-D1D2, C1-V1D2, C1-V3D2, C2-D2D1, C2-V2D1, C2-V4D1. In half of each trial type presentation, OR towards the S+ were under extinction. In these trials, only sample and S- were observed.

AB/BC reject training review. After CD training, AB/BC conditional relations were revised. If participants' performance was maintained, AB/BC/CD training started.

AB/BC/CD reject training. AB/BC/CD sessions were comprised of one AB/BC session mixed with a CD session. Sessions had 72 trials, 24 trials for each set of conditional relations (AB, BC, CD). After achieving criterion, one AB/BC/CD session was ran without feedback. If performance was maintained, one- and two-node tests began. If not, participants would be reassigned for another AB/BC/CD training session.

Figure 2. Conditional discrimination training (upper portion) and equivalence test (lower portion) programmed for Experiment 2. A diamond on the end of each solid line indicates that reject control was biased during training. Dashed lines indicate derived relations that were tested. Black and grey colors differentiated equivalence classes expected to be established.

Equivalence tests. Test sessions evaluated participants' responses to the following derived relations, in this order: one-node transitivity (BD), symmetry (DC), one-node equivalence (DB), two-node transitivity (AD), two-node equivalence (DA) and reflexivity (DD). Sessions were comprised of 24 baseline (AB/BC/CD) trials and 16 test trials. Test-trial types were: for BD test, B1-D1D2 and B2-D2D1; for DC, D1-C1C2 and D2-C2C1; for DB, D1-B1B2 and D2-B2B1; for AD, A1-D1D2 and A2-D2D1; for DA, D1-A1A2 and D2-A2A1; and for DD, D1-D1D2 and D2-D2D1.

Simple-discrimination training and transfer-of-function test. During the simple discrimination training, A1 and A2 were displayed across trials as described for the Reject phase simple-discrimination training, on Experiment 1. During the transfer-of-function test, all stimuli from sets, A, B, C and D were presented across trials and responses to keys A or L were recorded. A test session was comprised of 80 trials. During this session, each stimulus from each set (A1, A2, B1, B2, C1, C2, D1 and D2) was randomly presented for 10 trials.

Results

Participants took one session to meet criterion on CD training, no more than two sessions on AB/BC review, and one session on AB/BC/CD reject training and AB/BC/CD under extinction.

Participants' results on equivalence tests are presented on Table 6. On one-node transitivity and equivalence tests (BD and DB), all participants had scores next to zero, exception made for GCC. Conversely, on two-node transitivity and equivalence tests (AD and DA), all participants had high scores. On DD-reflexivity test, most participants scored next to zero, exception made for GCC. On the DC-symmetry test, in general, participants had high scores. Data from PSG and RS were lost due to technical problems on a flash drive and are not displayed.

Results obtained during simple-discriminative training and transfer-of-function test are presented on Table 7. Participants took from one to two sessions to achieve criterion on the discriminative training. Equivalence class-formation under reject control is assumed when the following conditional relations are likely to be the case: A1 reject B2 / B2 reject C1 / C1 reject D2 and A2 reject B1 / B1 reject C2 / C2 reject D1 (see Figure 2). In such case, is also considered that the following equivalence classes are formed: A1B2C1D2 and A2B1C2D2 (cf. Johnson & Sidman, 1993). Thus, whenever key-A pressing occurred in at least 9 out of 10 trials given the presentation of A1, B2, C1, D2 and key-L pressing occurred in at least 9 out of 10 trials given the presentation A2, B1, C2 and D1 a result in accordance with reject-control establishment. All participants responded in accordance with reject control during transfer-of-function tests, exception made for GCC.

Table 6. Participants' results on Experiment 2 equivalence tests. It is presented the number of correct responses in 16 test trials during each test session. The pattern obtained during tests were classified as: 1) reject control, when low scores on transitivity, equivalence and reflexivity, and high scores on symmetry were found; 2) select control, when high scores were obtained in all tests; and 3) other, when neither reject nor select control patterns were found.

Participant	Equivalence tests						Pattern on test
	BD	DC	DB	AD	DA	DD	
ACH	0	16	0	16	16*	0*	Reject control
JPH	2*	15	0	15	16*	0	Reject control
PSG	0	Lost	1	15*	16*	0	Reject control
GCC	4*	16	6	14*	15	15	Other
GMD	2	13*	2	14*	16*	1	Reject control
RS	0	Lost	0	15	16	1	Reject control

*Note: Each * indicates one test repetition.

Table 7. Participants' results on Experiment 2 simple discrimination training and transfer of function tests. When responses to keys A or L occurred in 90% of the trials in which a given stimulus was presented, the alphanumerical signature of that stimulus was displayed below the respective key-pressing response. When both responses occurred for the same stimulus, no signature was displayed. When Key-A or Key-L responses occurred to stimuli related under reject control, results were classified as reject control; responses occurred to stimuli related under select control, results were classified as select control. When the same response occurred for stimuli that were not programmed to belong to the same class, responses were classified as "other".

Participant	Number of training sessions	Transfer of function test								Pattern on test
		Stimulus that controlled key pressing in at least 9 out of 10 trials								
		Key A				Key L				
ACH	1	A1	B2	C1	D2	A2	B1	C2	D1	Reject control
JPH	1	A1	B2	C1	D2	A2	B1	C2	D1	Reject control
PSG	1	A1	B2	C1	D2	A2	B1	C2	D1	Reject control
GCC	1	A1				A2				Other
GMD	1	A1	B2	C1	D2	A2	B1	C2	D1	Reject control*
RS	2	A1	B2	C1	D2	A2	B1	C2	D1	Reject control*

*Note: Each * indicates one test repetition.

Discussion

Experiment 2 expanded to four members equivalence classes under reject control. This manipulation allowed evaluating the effects of nodal distance upon equivalence test results. In addition to it, the participation of programmed S- in equivalence classes was evaluated having two S- as members of each class.

Most participants scored high on symmetry and on two-node transitivity and equivalence tests and scored low on reflexivity and on one-node transitivity and equivalence tests - exception made for participant GCC. This is the first data reported replicating Johnson and Sidman's findings (1993) on two-node tests. The present results are not only in accordance with that previous study (Johnson & Sidman, 1993), but also in agreement with Carrigan and Sidman's (1992) predictions.

During Experiment 1, all participants responded in accordance with select control on DD-reflexivity tests. On Experiment 2, most of them responded in accordance with reject control. These results suggest that reflexivity tests are indeed modulated by sample/S+ or sample/S- relations. However, contextual cues might modulate identity- or oddity-like responses in DD tests. The baseline training trials presented during such test, DE/EF in Experiment 1 and AB/BC/CD in Experiment 2, might have set the occasion for responding under reject or select control during DD-tests trials in each of the two experiments, respectively (cf. Carrigan & Sidman, 1992).

In equivalence studies, reflexivity tests are usually omitted. However, the present results suggest that they are a reliable measure of the establishment of select or reject control. Many studies have used tests with novel stimuli as a way to infer the establishment of select or reject control (e.g., Carr, Wilkinson, Blackman, & McIlvane, 2000; Dixon & Dixon, 1978; Stromer & Osborne, 1989). In such tests, in order to evaluate whether responses are under reject control, for example, the S+ is replaced by novel stimuli. If participants chose the novel stimulus, responses are assumed to occur under control of sample and S-. However, when responses occur under select

control, withdrawing the original S+ might mislead conclusions. Strong criticism has been addressed to such tests because they might change stimulus control established during training (for a detailed explanation, see Carrigan & Sidman, 1992; McIlvane, Withstandley, & Stoddard, 1984). Since Carrigan and Sidman (1992), reflexivity tests are suggested as an alternative to testing with novel stimuli. Future studies should present reflexivity test trials in order to track the establishment of select or reject control during the conditional discrimination training (cf. Carrigan & Sidman, 1992). Besides, when transitivity or equivalence tests with an even number of nodes are the only tests carried out to verify the formation of equivalence classes, reflexivity tests should not be omitted. Since such tests are not affected by nodal distance, they are important to clarify which sample/comparison relation was established (cf. Carrigan & Sidman, 1992; Johnson & Sidman, 1993).

The establishment of four-member equivalence classes under reject control allowed replicating Experiment 1 findings regarding the participation of programmed S- in equivalence classes. Transfer-of-function results suggests, again, that under reject control both programmed S+ and S- are members of the same equivalence class (A1B2C1D2, A2B1C2D1).

It is worthy noticing that the function originally established for D1 and D2 during Experiment 1 (D1 - press A; D2 - press L) were here reversed via derived relations. In Experiment 2, D1 and D2 indirectly acquired A2 and A1 discriminative functions, respectively (A2 reject B1 / B1 reject C2 / C2 reject D1; A1 reject B2 / B2 reject C1 / C1 reject D2). These results suggest that, in some cases, derived functions might prevail over those that were directly established. Future studies should investigate this topic evaluating what contextual cues modulate the transfer of derived functions or the maintenance of functions that were directly acquired. In the present study, the discriminative training with stimuli from set A and the stimulus sets presented during transfer-of-function test (A, B, C and D) might have served as a contextual cue for

derived functions to prevail. Another variable that might have put the transfer of derived functions in advantage was: the contextual cues that controlled directly established responses to D stimuli in Experiment 1 were completely absent in Experiment 2 - i.e. the discriminative training with D stimuli and tests with sets D, E and F.

Last but not least, it should be noticed that set D was related both under reject and select control with sets C and E, respectively. Therefore, by the end of Experiment 1 and 2, reject and select control "competed" for results on DD-reflexivity tests. As lined out above, Carrigan and Sidman (1992) predicted that contextual cues such as the baseline training trials presented along with tests trials should modulate results on reflexivity tests. Experiment 2 results go along with their analysis. However, although in cases like this results on reflexivity tests are still predictable depending on contextual variables, when select control is established for one part of the conditional discriminations and reject control is established for another (e.g. C reject D / D select E), results on transitivity and equivalence are uncertain (cf. Carrigan & Sidman, 1992). Experiment 3 investigated this issue.

EXPERIMENT 3

Reject- and select-control patterns, such as those observed in Experiment 1 and 2, are predictable results on equivalence-class formation tests when reject *or* select control are established for *all* conditional relations during training, respectively. However, it needs not to be the case. Some conditional relations might be composed of sample/S+ relations while some others of sample/S-. Suppose the participant learns C1 *reject* D2 and D2 *select* E2. According to Carrigan and Sidman's analysis (1992): "Variations in this type of control produce an anomaly with respect to the predictability of transitivity and equivalence tests" (p. 196). Taking the example above to illustrate: during the CE transitivity test, in which C1 is presented along with E1 and E2, what will the participant do? What response will prevail? C1 *reject* E2 or C1 *select* E2?

Experiment 3 aimed to evaluate transitivity, equivalence and also transfer-of-function test results when some of the stimuli presented during tests are related under reject and some under select control. In order to do that, all conditional relations that were trained across Experiment 1 and 2 were reviewed within the same session (see Figure 3) so that participants went through a session composed both by sample/S- (AB/BC/CD) and sample/S+ relations (DE/EF). After training review, tests involving stimuli related under reject (e.g., B) and under select control (e.g., E) were presented (e.g. BE and EB tests).

Method

Participants

Participants that showed reject-control patterns on Experiment 2 were assigned for Experiment 3: ACH, JPH, PSG, GMD and RS.

Setting, Equipments, Stimuli, Experimental Task and Biasing Procedures

The same described for Experiment 1.

Procedure

Experiment 3 is illustrated on Figure 3. It started reviewing AB/BC/CD conditional relations under reject control. After that, DE/EF conditional relations under select control were also reviewed. These sessions were followed by a short AB/BC/CD/DE/EF session. Once participants met criterion, another session was run without feedback. If performance was maintained, equivalence tests, simple-discriminative training and transfer-of-function tests were carried out. In general, the same guidelines described for Experiment 1 and 2 were followed.

AB/BC/CD reject training review. AB/BC/CD sessions were run until participants met criterion. The learning criterion was the same described for Experiment 1.

DE/EF select training review. DE/EF sessions were run until participants met criterion.

Short AB/BC/CD/DE/EF training. A short 40-trial session with all trained conditional relations was programmed. Eight trials for each set of conditional relations (AB, BC etc.) were randomly presented. If the criterion was achieved, another session was run without feedback. If performance was maintained, tests were carried out. If not, participants were reassigned for another AB/BC/CD/DE/EF training session.

Equivalence tests. Test sessions evaluated participants' responses during tests in which part of the conditional relations were under reject and part under select control. First, CE-transitivity and EC-equivalence tests were carried out; after that, one-node-under-reject-control transitivity (BE) and one-node-under-reject-control equivalence (EB) tests were presented followed by two-node-under-reject-control transitivity (AF) and two-node-under-reject-control equivalence (AF) tests. Sessions were comprised of 56 trials, 40 baseline training trials (AB/BC/CD/DE/EF) and 16 test trials. Test-trial types were: for CE test, C1-E1E2 and C2-E2E1; for EC, E1-C1C2 and E2-C2C1; for BE, B1-E1E2 and B2-E2E1; for EB, E1-B1B2 and E2-B2B1; for AF, A1-F1F2 and A2-F2F1; and for FA, F1-A1A2 and F2-A2A1.

Simple-discrimination training and transfer-of-function test. During the simple discrimination training, A1 and A2 were displayed across trials as described for the phase Reject simple-discriminative training, on Experiment 1. During the transfer-of-function test, all stimuli from sets, A, B, C, D, E and F were presented across trials. A

test session was comprised of 100 trials. During this session, each stimulus from each set (A1, A2, B1, B2, C1, C2, D1, D2, E1, E2, F1 and F2) was randomly presented for 10 trials.

Figure 3. Conditional discrimination training (upper portion) and equivalence test (lower portion) programmed for Experiment 3. A circle or a diamond on the end of each solid line indicates that reject or select control was biased during training, respectively. Dashed lines indicate derived relations that were tested. Black and grey colors differentiated equivalence classes expected to be established.

Results

Participants took one session to met criterion on AB/BC/CD review, no more than two sessions on DE/EF review, from one to three sessions on AB/BC/CD/DE/EF training and one session on AB/BC/CD/DE/EF under extinction.

Participants' results on equivalence tests are presented on Table 8. On CE-transitivity and EC-equivalence tests all participants had high scores, exception made for RS.

Table 8. Participants' results on Experiment 3 equivalence tests. It is presented the number of correct responses in 16 test trials during each test session.

Participant	Equivalence tests					
	CE	EC	BE	EB	AF	FA
ACH	15	14	0	1	13	14
JPH	16*	16	0	1	16	15
PSG	14	14	3	14	14	-
GMD	16	16	1	14*	2	0
RS	6	9	8	8	8	0

Table 9. Participants' results on Experiment 3 simple-discrimination training and transfer-of-function tests. When responses to keys A or L occurred in 90% of the trials in which a given stimulus was presented, the alphanumerical signature of that stimulus was displayed below the respective key-pressing response. When both responses occurred for the same stimulus, no signature was displayed.

Transfer of function test												
Participant	Stimulus that controlled key pressing in at least 9 out of 10 trials											
	Key A						Key L					
ACH	A1	B2	C1	D2	E2	F2	A2	B1	C2	D1	E1	F1
JPH	A1	B2	C1	D2	E1	F1	A2	B1	C2	D1	E2	F2
GMD	A1	B2	C1	D1	E1	F1	A2	B1	C2	D2	E2	F2
RS	A1	B2	C1	D2	E1	F1	A2	B1	C2	D1	E2	F2

On one-node-under-reject-control transitivity test (BE), three participants had a next to zero score (ACH, JPH, GMD) and two participants had medium scores (PSG and RS). During one-node-under-reject-control equivalence test (EB), two participants scored next to zero (ACH, JPH), two participants had a high score (PSG, GMD) and one participant had a medium score (RS). On two-node-under-reject-control transitivity test (AF) two participants had a high score (JPH, PSG), one had a medium score (ACH, RS) and one participant had a next to zero score (GMD). Finally, on two-node-under-reject-control and equivalence test (AF), two participants had a high score (ACH and JPH) and two scored next to zero. PSG quit the experiment before FA test was run.

All participants had only one simple-discriminative-training review. Results obtained during transfer-of-function test are presented on Table 9. ACH, JPH and RS kept responding to A, B, C and D stimuli like they did in Experiment 2. Concerning E and F stimuli, JPH and RS kept responding like they did in Experiment 1; ACH reversed key-pressing responses. For GMD, results on transfer-of-function test were the same observed during Experiment 1.

Discussion

Experiment 3 evaluated the effects of reject and select control competition upon transitivity, equivalence and transfer-of-function tests. Results suggest that during transitivity and equivalence tests involving one stimulus set related under reject and another under select control, participants tended to respond under reject control, and therefore scored high. This assumption is based on the stimulus relations that were taught during training. For example, after having learned C1 *reject* D2 / D2 *select* E2, when C1 was presented along with E1 and E2 during CE transitivity tests, participants performed C1 *reject* E2, and E1 was chosen. The only exception was RS, who had medium scores.

Results of participants ACH and JPH on one- and two-node-under-reject-control tests suggest that the number of nodes involved in sample/S- relations (CE, EC, BE, EC tests) determined, again, the flip-flop effect previously observed on transitivity and equivalence tests (see Experiment 2), systematically replicating Johnson and Sidman (1993). Two participants (PSG and GMD), however, responded differently during BE and EB tests. For these participants, the type of control that prevailed, reject or select, might have been ruled by the sample. Considering that the following relations were learned, B1 *reject* C2 / C2 *reject* D1 / D1 *select* E1, when E1 was presented as sample and B1 as comparison, participants performed E1 *select* B1; when B1 was presented as sample and E1 as comparison, they performed B1 *reject* E1 (see Figure 3 to track all relations that were taught). In such tests, participant RS had medium scores

Carrigan and Sidman (1992) suggested that when different types of control are established and compete during tests, results are unpredictable. What relation will prevail when tests are presented, reject or select? The present results suggest that reject control tends to prevail. However, when the number of nodes increases, participants might respond under select control, especially if they start the experiment learning sample/S+ relations. AF and FA test suggests that the order of experimental phases might also influence the likelihood of performances under select or reject control. Participants that started at phase Reject (ACH, JPH, PSG) responded under reject control and had high scores on such tests (e.g., F1 *reject* A2); conversely, participants that started on phase Select (GMD, RS) performed under select control and, in general, had low scores (e.g. F1 *select* A2).

Previous studies evaluated the effects of select *or* reject control when such controls were separately established for different stimulus sets (Magnusson, 2002; Perez, 2008; Perez & Tomanari, submitted; Tomanari et al., 2012). So did de Rose et al. (in press) after biasing select *and* reject control for all conditional discriminations and also biasing reject control for some of them. Experiment 3 evaluated equivalence

test results when conditional relations for some stimulus sets are under reject (AB/BC/CD) and some under select control (DE/EF). Participants' performances varied when reject and select controls competed during tests. However, when one stimulus set was related to two other sets having one under reject (CD) and another under select control (DE), reject control tend to prevail during transitivity and equivalence tests (see, BE and EB tests).

Results on transfer of function tests varied across participants. For three out of four participants (ACH, JPH and RS), the derived discriminative function prevailed for D stimuli. The only exception was participant GMD. For participant ACH, the derived functions observed for E and F stimuli were also reversed when compared to Experiment 1. JPH, RS and GMD, however, kept responding E and F stimuli as they did in Experiment 1. Participants' responses to D stimuli suggest that derived functions tended to prevail over directly established functions even when contextual cues from phase Select were present, such as stimuli from sets E and F. These results suggest that the repetition of discriminative training involving set A and not set D might be a critical variable. However, responses observed to E and F stimuli suggests that derived functions previously acquired tended to be maintained even when such stimuli were turned into members of a novel class with the opposite function (compare Figure 1 and 3 following dark and gray arrows).

GENERAL DISCUSSION

A series of three experiments on reject and select controls was presented. In Experiment 1 (a) reject and select-control patterns were largely replicated across participants and conditions, corroborating previous analysis (Carrigan & Sidman, 1992) and experimental findings (e.g., Johnson & Sidman, 1993; Perez & Tomanari, submitted). Such results also suggests that the biasing procedures used during training, that is, the combination of different proportions of S+/S- with the MTS-OR

procedure, were effective in establishing sample/S- and sample/S+ relations (for suggestions of future research topics using the MTS-OR, see Hamasaki, 2009; Perez & Tomanari, submitted). In addition (c), Experiment 1 results on transfer-of-function tests suggest that, as assumed in previous studies (Carrigan & Sidman, 1992; Johnson & Sidman, 1993), different equivalence classes are formed under reject and select control. In the former case, programmed S+ and S- are turned into members of the same class; in the latter case, equivalence classes are formed only by programmed S+.

Experiment 2 (a) corroborated previous studies (Carrigan & Sidman, 1992; Johnson & Sidman, 1993) concerning the effects of nodal distance upon transitivity and equivalence test results. Low scores on transitivity and equivalence tests were observed only when an odd number of nodes related under reject control was involved; when tests involved an even number of nodes, results did not differ from those under select control. The second experiment also (b) reinstated that results on reflexivity tests are indeed modulated by the establishment of sample/S- or sample/S+ relations, and are not affected by nodal distance. Transfer-of-function-test results for D stimuli (c) replicated Experiment 1 findings and showed that class expansion under reject control added another programmed S- in each equivalence class. Last but not least, participants' responses to D stimuli suggest an interesting finding (d): the response that was directly trained for D stimuli (D1, press A; D2 press L) was not the one that showed up during transfer-of-function tests. In this phase, some participants responded inversely when compared to how they were taught to do so in Experiment 1, but in accordance with the relations that were trained along Experiment 2. These results suggest that in some cases derived functions might prevail over those that were directly established.

Finally, Experiment 3 (a) was the first to evaluate results on equivalence tests and transfer of function when one part of the conditional discriminations is under reject

(AB/BC/CD) and another under select control (DE/EF). Such stimulus-control competition was assumed to yield unpredictable results (cf. Carrigan & Sidman, 1992). However, given the conditions of the present experiment, (b) reject control tended to prevail in some of the tests (CE and EC). Transfer of function test results (b) replicated Experiment 2 findings concerning D stimuli; again, derived functions were more likely to occur when compared to those that were previously established via direct contingencies. However, concerning E and F stimuli, derived functions were not updated after ABCD and DEF classes were joined.

Two general comments still have to be made. The first of them concerns the use of reflexivity test in equivalence experiments. As point out before, reflexivity tests are usually omitted from the test pack suggested by Sidman & Tailby (1982). The present results, however, suggest that they are important to identify select and reject control, especially when two-choices are used. High scores on transitivity and equivalence tests were found when (a) one part of the conditional relations were under reject (C reject D) and another under select control (D select E) and also when (b) tests involved an even number of nodes under reject control. These results could be generally taken as an evidence of equivalence class formation in accordance with select control. Reflexivity tests revealed that it was not the case. For that reason, researchers should consider to have such tests back in their equivalence-test protocol.

The second general comment concerns the interpretation of results on transfer-of-function tests. In the present study, the transfer of function observed on phases Reject and Select depended upon the sample/comparison relation that was biases during training (sample/S- or sample/S+). Although a linear series was used during training (AB/BC/CD and DE/EF), the present results are hard to account for in terms of classical conditioning because the stimulus set for which the discriminative function was originally established never followed the presentation of any other stimulus set. Phrasing differently, no stimulus from other sets (B, C, D, E or F) served as conditional

stimulus (CS) and was followed by stimulus from set A as unconditioned stimulus (US) (see O'Toole, Barnes-Holmes and Smyth, 2007, for a detailed discussion of this topic). Nonetheless, one may suggest that during equivalence tests, when stimuli from set A were presented as comparisons (e.g. CA), the necessary conditions for stimulus pairing might have taken place. If any stimulus pairing had occurred, conditioning would depend on which comparison (US) was displayed after the sample was observed (CS). However, since no window was locked during test trials, both comparisons had to be observed before proceeding (i.e. in terms of classical conditioning, there were two unconditioned stimuli). Considering that comparison stimuli were covered, it is fair to assume that sample presentations were followed by A1 and then A2 presentation or vice-versa each in 50% of the trials. In this case, what discriminative function would transfer to sample stimuli, A1's or A2's? Again, results during tests are not readily explained by stimulus pairing. In addition to it, considering that stimuli were always covered and, because of that, were never simultaneously presented, other associative processes such as stimulus compounding (cf. Dougher & Markhan, 1994) are not likely to account the present data.

When it comes to transfer of function as a phenomenon of real life, some sort of contextual control must always be assumed to be the case. Otherwise, all stimuli in a given class would acquire the functions of all other stimuli to which they are related to through equivalence. Although such contextual control is a widely accepted assumption (Sidman, 1986, 1992, 1994; Hayes, 1991; Hayes, Barnes-Holmes, & Roche, 2001), few studies have addressed this topic (Dougher, Perkins, Greenway, Koons, & Chiasson, 2002; Perkins, Dougher, & Greenway, 2007). Transfer of function tests results to D stimuli suggest that derived functions acquired via transfer of function on Experiment 2 and 3 might prevail over those that were directly established, in Experiment 1. These results suggest that contextual control might operate not only upon which stimulus function will transfer, and to what members of a given class

(Sidman, 1992; Hayes et al., 2001; Dougher et al., 2002), but might also determine if derived function will prevail over those that were acquired through direct contingencies. This is a topic of main importance for research areas such as rule-governed behavior (Törneke, Luciano, & Salas, 2008; Barnes-Holmes, O'Hora, Roche, Hayes, Bisset, Lyddy, 2001) and also for behavioral therapies whose interventions are extensively based on relational responding and on altering the context that control stimulus functions instead of the stimulus functions themselves (e.g., Dougher & Hackbert, 1994; Hayes, Strosahl, & Wilson, 2012). As pointed out by Dougher et al. (2002), the failure to develop appropriate contextual control over transfer of function may lead to problematic behavior, that is, inappropriate or maladaptive responding to certain stimulus classes. It is beyond the scope of the present study the identification and manipulation of contextual cues that control transfer of function, however, it presented new data highlighting a new avenue for future research: What variables modulate the likelihood of directly acquired or derived functions to prevail?

Select and reject controls have been a constant topic in matching-to-sample studies over the years (Berryman, Cumming, Cohen, & Johnson, 1965; Carr et al., 2000; de Rose et al., in press; Dixon & Dixon, 1978; Johnson & Sidman, 1993; Kato, de Rose, & Faleiros, 2008; McIlvane et al., 1984; Stromer & Osborne, 1982; Perez & Tomanari, submitted). It is a relevant topic, especially because these different types of stimulus control seems to underlie different cases of complex behavior such as generalized identity or oddity from sample (Santi, 1982; Urcuioli, 1977; Urcuioli & Nevin, 1975), learning by exclusion (McIlvane, Kledaras, Munson, King, de Rose, & Stoddard, 1987; McIlvane, Munson, & Stoddard, 1988; Wilkinson, Dube, & McIlvane, 1996; Wilkinson & McIlvane, 1997), generalized conditional responding (Saunders & Spradlin, 1990, 1993; Saunders & Williams, 1998) and equivalence itself (Carr et al., 2000; Kato et al., 2008; de Rose et al., in press). Carrigan and Sidman's (1992) theoretical article proposes a research agenda that is worth to pursue. However, in

order to do that, studies should manipulate the establishment of select and reject control during training in order to evaluate its effects upon equivalence-class formation tests results. Few published studies have done that (de Rose et al., in press; Johnson & Sidman, 1993; Perez & Tomanari, submitted; for nonpublished studies, see Magnusson, 2002; Tomanari et al., 2012; Perez, 2008; Perez & Tomanari, 2011). Most of the research questions raised by Carrigan and Sidman are waiting for investigation. Further research is needed.

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CONCLUSÃO

Ao longo dos três capítulos que compõem a presente tese de doutorado, foram apresentados procedimentos e resultados que abrem novos caminhos para o estudo dos controles por seleção e por rejeição.

No Capítulo 1, foi apresentada uma revisão da literatura da área. Tal revisão, focada em questões metodológicas, sistematizou os procedimentos utilizados para inferir a ocorrência dos controles por seleção e por rejeição, bem como os procedimentos empregados para manipulá-los experimentalmente. Os procedimentos encontrados foram descritos e analisados criticamente. Por fim, foi sugerida a necessidade de se desenvolver procedimentos que favoreçam a ocorrência dos controles por seleção ou por rejeição ao longo da realização do treino das discriminações condicionais.

No Capítulo 2, foi apresentado um experimento que, em linha com os pontos sugeridos pelo Capítulo 1, investigou o efeito da manipulação da observação dos estímulos de comparação sobre o estabelecimento dos controles por seleção e por rejeição durante o treino de discriminações condicionais. Para tanto, foi utilizado o procedimento de emparelhamento com o modelo com observação requerida (MTS-OR). Os resultados sugerem que a ocorrência do controle por seleção foi mais provável para os participantes que foram exigidos observar o S+ ao longo de todas as tentativas de treino; o controle por rejeição, por sua vez, só ocorreu para os participantes que foram exigidos observar o S-. Além disso, nesse último caso, impedir os participantes de observar o S+ favoreceu o estabelecimento do controle pelo S-.

No Capítulo 3, teve-se como principal objetivo avaliar o efeito dos controles por seleção e por rejeição sobre a transferência de função. O procedimento de MTS-OR, aliado ao uso de diferentes proporções de S+/S-, permitiu a manipulação experimental dos controles investigados. Os dados apresentados confirmam previsões anteriores que sugerem a formação de diferentes classes de equivalência a depender do controle

estabelecido. Foram investigadas ainda, com um número considerável de participantes, algumas das análises de Carrigan e Sidman acerca: a) dos efeitos dos controles por seleção e por rejeição sobre os testes de formação de classes de equivalência; b) da modulação dos resultados dos testes de transitividade e equivalência em função do número de nodos envolvidos; c) da utilidade dos testes de reflexividade; d) de situações nas quais a "competição" entre esses dois controles torna os resultados dos testes imprevisíveis.

Considerando a divisão apresentada na revisão metodológica, resta concluir que o presente trabalho trouxe contribuições com relação ao desenvolvimento tanto de procedimentos de mensuração quanto de manipulação experimental dos controles por seleção e rejeição. O uso dos testes de transferência de função como medidas de ocorrência desses controles merece estudos futuros. Novas pesquisas poderão investigar a transferência, via seleção ou rejeição, utilizando outras funções de estímulo (respondente, por exemplo), bem como medidas contínuas, em vez de binárias. Com relação ao procedimento MTS-OR, inúmeros parâmetros ainda precisam ser investigados, dentre eles o efeito da variação no tempo de apresentação de cada comparação (S+ e S-) e o custo de resposta para produzir a apresentação de cada estímulo.