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Using Contextual Cues to Influence the Role of Priming in the Transformation of Stimulus Functions: A Relational Frame Theory Investigation in Implicit Social Stereotyping.

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Using Contextual Cues to Influence the Role of Priming in the Transformation of
Stimulus Functions: A Relational Frame Theory Investigation in Implicit Social
Stereotyping

by

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A thesis submitted in partial fulfillment
of the requirements for the degree of
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ABSTRACT

This basic study was designed to explore the conceptualization of prejudice as a form of contextually controlled, derived, and arbitrarily applicable relational responding. Basic studies utilizing RFT methodologies have yielded examples of how stimulus functions of one set of stimuli, such as a stereotyped group, can transform the functions of another stimulus, such as an individual. Priming procedures, as contextual cues, have been used to affect prejudicial responding. Stimuli participating in relational frames have been shown to be sensitive to such priming procedures; however, the role of context in the priming of derived relational responses has not yet been established. In the present study, 11 participants were trained to respond to four 3-member equivalence classes, consisting of word-like stimuli, under the contextual control of two background colors. Participants then completed a single-word lexical decision task in which prime/target pairs, consisting of related and unrelated pairs, were presented with and without contextual cues. For participants who successfully completed the training phase, response latencies to identify related pairs were generally shorter than for pairs involving a neutral word. However, response latencies between related pairs and unrelated pairs, consisting only of previously trained stimuli, failed to meet statistically significant differentiation. Responses were also similar between contextually related and contextually unrelated word pairs. The results failed to indicate the presence of a contextually controlled semantic priming effect at a statistically significant level; however, these results do suggest the possible presence of an episodic priming effect.

Introduction

The formation of prejudiced and stereotyped responding is difficult to explain from a traditional behavior analytic account. Prejudicial responding involves the application of feelings or attitudes toward a novel person or object. Though behavior principles, such as stimulus generalization, may explain how an organism may respond to novel stimuli in a similar manner as to previously experienced stimuli, these responses can hardly be called prejudice. For example, a dog may be aggressive towards all men due to an experience with an abusive previous male owner; however such a response is limited solely to the formal properties of the stimuli involved. While stimulus generalization may account for the response of the dog, instances of human prejudice often involve symbolic, semantic, or otherwise arbitrary stimuli and functions. It is therefore difficult to use stimulus generalization to account for how one might, hearing a news report that Osama Bin Laden is responsible for the Sept. 11th attacks, come to distrust novel Islamic individuals. Though some of the participating stimuli will always involve similarities between non-arbitrary features, such an example of prejudice would require the individual to engage in many complex verbal behaviors, allowing them to not only understand the meaning of the original news report but to then apply subsequent functions to novel individuals that are only related indirectly through the use of language (c.f. Hayes et al., 2002). Prejudice, therefore, can be viewed as a verbal event and thus susceptible to contextual cues, even when these cues are from unattended sources such as priming. The view in this paper accounts for prejudice as a form of derived relational

responding to arbitrary cues, a position suggested by Relational Frame Theory (Hayes, Barnes-Holmes, & Roche, 2001). The following section serves to review experimental applications of this theory to the dismantling of pre-experimental prejudicial responding, and to propose a conceptual demonstration of how contextual cues influence measures of implicit prejudicial responding.

Relational Frame Theory

Relational frame theory (RFT) is a behavior analytic account of the development and utilization of complex responses, such as language and cognition (Hayes, Barnes-Holmes, & Roche, 2001). Where Skinner's analysis of verbal behavior (1957) focuses on a description of response taxonomies related to the three-term contingencies that maintain them, the focus of RFT is on an over-arching operant class of arbitrarily applicable derived relations (Hayes, Barnes-Holmes, Roche, 2001). All psychological relations involve a situation in which the stimulus function of one event is dependent on the stimulus function of another event; such relations are accounted for in a number of behavioral approaches. However, RFT specifically addresses those relations that are derived, arbitrarily applicable, learned, and controlled by context (Hayes, 1994 p10). In order to better understand these characteristics, it is first important to address relational responding as a generalized operant class.

Generalized Operant Classes

Operant behaviors are described by the changes in probability of responses dimensions as related to the environmental consequences. Therefore, a number of behavioral topographies can generate the same change in the environment, despite having no formal similarity. A child who wishes to garner the attention of a care-taker may cry, throw objects, slam a door, or state "come here." Though these behaviors differ in physical form, they are said to be functionally equivalent; in which case they are said to

be a part of the same functional class. When the topographies of a class of responses cannot be described by their formal features, yet the functional relation between the responses and consequences are the same, a generalized or over-arching operant class is said to have formed (Barnes-Holmes & Barnes-Holmes, 2000). Such a functional relationship, despite topographical differences, is easily seen in gross-motor imitation, where the response form is different for every gesture yet the relationship between mimicking the model and receiving reinforcement is always the same. Generalized operant classes are the result of multiple exemplars, in which the abstracted features relevant to responses of that class, are trained given an appropriate context. In the example of gross-motor imitation, a history with enough examples of “do this” and different modeled gesture followed by needed prompts and reinforcement, results in the generalized operant of mimicking novel gestures without significant further training. Relational responding shares this characteristic, as the act of responding to a relation between two stimuli, is easily described in reference to function, yet no formal description of topography adequately describes the response class (Hayes, Barnes-Holmes, Roche, 2001). If relational responding is a generalized operant, resulting from a history of exemplars and is not reliant upon specific stimuli but rather a relation between multiple stimuli, it can be expected that relational responses to novel stimuli may emerge without direct training. However, such responses would only be novel with respect to the stimuli, since a history of relating two stimuli in a particular way is the result of an operant history. Therefore, untrained responses of relating, given the history previously described, are predicted by an operant account (Barnes-Holmes & Barnes-Holmes, 2000; Hayes, Barnes-Holmes, Roche, 2001, Skinner, 1953).

Derived Relational Responding

Relational responding to the formal properties of stimuli has been demonstrated across a number of organisms, human and non-human (Hayes, Barnes-Holmes, Roche, 2001). Harmon, Strong, & Pasnak (1982) trained rhesus monkeys to discriminate between stimuli on the basis of formal properties, a form of relational responding known as transposition. The monkeys were reinforced for selecting the taller of two differently colored blocks. When a taller novel colored block was introduced, the monkeys reliably selected the novel block, suggesting a generalized relational response of identifying the block with the tallest height.

Despite allowing for the relational responses between novel stimuli, transposition does not readily apply to the abstract relations that are characteristics of language. Transposition requires a formal property to be related, such as taller than or quieter than. However, many words in the English language have no formal similarity between words that are related or words and their spoken form; the written word “Cat” is not shaped like a cat nor does it have the auditory stimulus features of the spoken word cat, yet these two words can be related. For this reason, RFT differentiates derived relations from those of transposition, as being based on the non-formal properties of stimuli (Hayes, Barnes-Holmes, Roche, 2001).

Arbitrarily Applicable Relational Responding

In addition to the stimuli to be related, the context in which relational responding occurs is not always related to the physical properties of the situation, but rather can be based on arbitrary aspects of stimuli in the presence of which a history of reinforcement

has increased the probability of a particular type of relational responding. The particular stimulus events that comprise a context are referred to as contextual cues.

Because a contextual cue is not specific to the particular stimuli that are related but rather to the relation to be applied, contextual cues are arbitrarily applicable. As such, any relational response can be brought to bear upon any stimuli given the presence of the appropriate contextual cue. For example, a dime can be said to be bigger than a nickel, despite the fact that the formal properties of a nickel are physically larger than those of the dime. This type of responding is of primary interest in Relational Frame Theory and is referred to as arbitrarily applicable relational responding. It should be noted that contextual cues, as intended here, are arbitrarily applicable but not necessarily arbitrarily applied, as the verbal community may explicitly train the appropriateness of particular contextual cues to particular classes of stimuli (Hayes, 2004; Hayes, Barnes-Holmes, Roche, 2001 p25-29). .

The relation specified by a contextual cue, such as same/opposite or bigger than/less than, are referred to as relational frames; the response in action being described as framing events relationally (Hayes, 2004; Hayes, Barnes-Holmes, Roche, 2001).

Three properties define the derived outcomes of framing events relationally; those are mutual entailment, combinatorial mutual entailment, and the transformation of stimulus functions (Hayes, 2001).

Defining Properties of Relational Frames

Though similar to the equivalence properties of symmetry, transitivity, and the transfer of stimulus function, the properties of a relational frame are more general with regards to the bi-directional nature of the derived relations possible. While equivalence

relations specify a similar function (e.g. the printed word cat and the auditory word cat have the same function), relational frame theory suggests that with contextual control, a wide variety of relations can be derived, therefore requiring terms that adequately describe relations other than equivalence (Hayes, Barnes-Holmes, Roche, 2001). It should be noted that while reflexivity is accepted as a possible relation within Relational Frame Theory, it is considered necessarily based on formal attributes and thus requires no further term to describe it (Hayes, 2001 p33; Steele and Hayes, 1991).

Mutual entailment. When relating two events, the subsequent relation is always mutual, regardless of the specific relation employed. If stimulus A is related to stimulus B, then B is related in some way to A. The first relation is specified, and the second relation is thus entailed. However, as can be inferred, this does not necessarily suggest a relation of symmetry (if A is equal to B, then B is equal to A), since the relation in question could include a variety of frames. For example, if A is larger than B, then it is entailed that B is smaller than A. Therefore, the term mutual entailment is used to describe a derived relational response in which a bidirectional relation is established by training one direction of the response (Hayes, 2001). See figure 1.

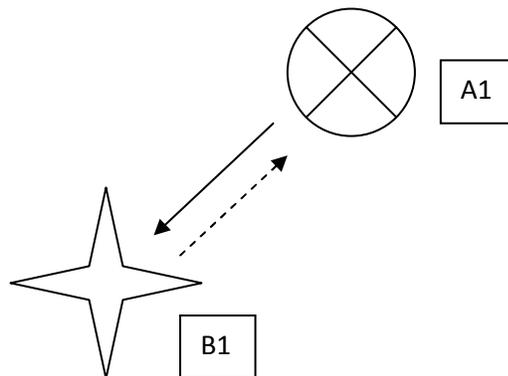


Figure 1. Mutual Entailment: The two arbitrary stimuli (noted A1 and B1) are mutually entailed. A solid black arrow indicates a directly trained relation, (A1 is related to B1,) and a dotted line indicates the derived (untrained) relation (B1 is related to A1).

Combinatorial mutual entailment. When two or more mutually entailed relations combine, such that a relation is derived between events that had no direct training in either direction, combinatorial mutual entailment has been established (Hayes, 2001). If A is larger than B, and B is larger than C, relations can be derived between A and C which have never been trained or presented together. In this instance, A is larger than C and C is smaller than A. Again, the equivalence term transitivity cannot adequately describe the bi-directionality of such a relation (Hayes, 2001). See figure 2.

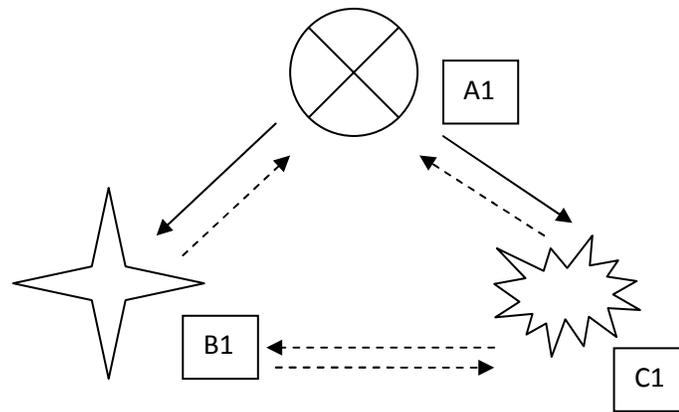


Figure 2. Combinatorial Mutual Entailment: Though no directly trained relation (solid black line) is present between A1 and C1, a derived relation (dotted line) can be established based on the combined mutually entailed relations of A1 to B1 and B1 to C1.

Transformation of stimulus functions. If a relational response is the determining of the function of one event as dependent on another, then a change in the function of one event would affect the functions of dependent events. Therefore, by relating each event, the functions of those events are transformed across the relational frame (Hayes, 2001). For example, if A is the opposite of B, and C is the same as B, a derived relation of C being the opposite of A results. If A was then trained same as B, the derived relations between A and C would be transformed in accordance with the specified A-B relation, such that A-C would now be the same. This transformation of

stimulus functions across relational networks has been observed with a number of psychological functions. For example if stimuli A, B, and C are in a frame of coordination (equivalence), and stimulus A is directly conditioned as a positive reinforcer, then the reinforcement function of A should transform the stimulus functions of B and C to be that of a conditioned reinforcer (Hayes, Kohlenberg, & Hayes, 1991). Subsequently, if the reinforcement function of A is extinguished, the resulting transformation of stimulus functions across the relational frame would show the loss of reinforcement functions in both B and C (Dougher et al., 1994). The term transformation, instead of transfer, is used since the term transfer limits the changes in stimulus functions to the specific function altered (Hayes, 2001). If A is the opposite of B, and C the opposite of B, a network of relations in which A and C are the same and both are the opposite of B would exist. If a punishing function was conditioned to A, then C would also become a punisher, however B may likely become a reinforcer. It cannot be said that the punishing function of A transferred to C, but rather the function of A transformed the function of C by virtue of their participation in the relational frame with B (Dymond & Barnes, 1996).

Context and multiple stimulus functions. As specified earlier, a relational frame exists when events are related in the presence of contextual cues. Contextual cues, from a relational frame theory perspective, are stimulus events that specify the specific relations and functions of the stimuli participating in the relational frame (Hayes et al., 2001). In a sense, such contextual control refers to a sort of higher-order conditional discrimination in which the presence of such a stimulus event determines, through a history of reinforcement, how other events are related (Dougher, Perkins, Greenway,

Koons, & Chiasson, 2002). When a contextual cue specifies the specific relation to be applied, such as same/opposite, it is referred to as a contextual relation or C_{rel} . However, stimuli can have more than one function and thus further specification, via contextual cues, are necessary to discriminate which function is relevant. Consider the stimulus words “Cat” and “Dog”; when asked to relate them you may respond with opposite, however in the context of “mammal or reptile” the same stimuli “Cat” and “Dog” may be related as being the same. In this example, “mammal or reptile” served as a contextual cue that specified the function of the stimuli to be related. In such a case, the contextual cue is referred to as a C_{func} . Contextual cues can themselves be arbitrary, having been established through a history of responding within the verbal community. Without multiple stimulus functions and contextual cues to mediate the specifics of how stimulus functions are related, relational networks would become incomplete and rendering all arbitrary stimulus functions identical (Hayes et al., 2001). However, when relational networks are complete, particular functions of stimuli can be individually transformed, while maintaining other functions as established by participation in multiple relational frames.

Toward a Relational Frame Theory Account of Prejudice

If arbitrarily applicable relational responding can establish networks of interdependent stimulus functions without directly training the multiple functions of each stimulus, then it is easy to describe how a negative stimulus function could be applied to a specific stimulus and through participation in relational frames with other stimuli, transform the functions of the related stimuli. Barnes-Holmes, Keane, Barnes-Holmes, and Smeets (2000) demonstrated this process by having participants form two relational frames of coordination by directly training emotive words (Cancer/Holidays), to nonsense words (Vek/ZID), and the nonsense words to arbitrary soft drink brands (Brand X/Brand Y). The formation of the two relational frames were then assessed, i.e. that a combinatorial mutually entailed relation was demonstrated between emotive words and brands. Participants were then asked to rate the pleasantness of Brand X and Brand Y on a 7 point Likert scale. Results indicated that the participants who demonstrated the combinatorial relation between emotive words and brands, showed a significant discriminated preference for the brands, respective to which emotive word they were related. Therefore, the derived relation with the emotive functions of “Holiday” and “Cancer” transformed the function of the related brand, such that one would be rated as more pleasant despite the drinks being identical in taste. This effect was replicated with children by Smeets and Barnes-Holmes (2003), however the emotive stimuli of a cartoon child smiling or crying were used. Again the participants were exposed to a matching to

sample task resulting in the formation of two frames of coordination; emotive stimuli to an arbitrary geometric shape (A-B relation), and the arbitrary shapes to a second set of arbitrary geometric shapes (B-C relations). The children were then presented with two brands of soda, designated by one of the second set of geometric shapes (C stimuli). Not only did participants rate the brand related to the smiling child as more pleasant, but they also chose to taste that brand of soft drink first. This demonstrated a clear preference, through both approach and report, for one brand over the other by way of a transformation of stimulus functions across derived relations.

This process demonstrates how a negative valence or non-preferential response to a network of stimuli based on experience with only a few members of that network could emerge via relational responding; a situation when applied to people and group membership could be called prejudice.

Construction of a Prejudicial Relational Frame

Relational frame theory conceptualizes prejudice as a “derived transformation of the functions of individuals based on direct or verbal contact with the functions of a few members of a conceptualized group” (Hayes, 2001). In this case, a conceptualized group exists to a person when multiple individuals (or stimuli) come to participate in a frame of coordination under the contextual control of shared characteristics (Hayes, 2001). Take racial categorization for example; under the context of same and skin color, an individual may conceptualize people into groups such as black or white. Those same individuals may be further grouped in the context of male/female, tall/short, fat/thin, English speaking, domestic/foreign, etc. See figure 3 for example of such contextually controlled

conceptual groups. Though these examples are non-arbitrary, the context that they are framed in is arbitrarily applied.

Once the functions of stimuli, or in this case of individuals, come to participate in relational frames with the functions of other stimuli, transformation of stimulus functions can occur across the relational network. Therefore, if a stimulus with negative functions comes to participate in a frame of coordination with the contextually relevant characteristics of a conceptualized group, the negative functions can transform the functions of the individual group members. For example, if the negative functions of the stimulus “terrorist” come into a frame of coordination with middle-eastern clothing, then it is possible that the negative functions may transform other stimuli that are in coordination with middle-eastern clothing, such as food, ethnic appearance, or religion (Dixon, Zlmonke, & Rehfeldt, 2003). Due to the bi-directionality of relational networks, the same process can be seen to work in reverse, where an arbitrary stimulus may gain psychological functions through a newly acquired relation with groups holding pre-existing functions. Weinstein, Wilson, Drake, and Kellum (2008) demonstrated how bias toward obesity-related stimuli could transform arbitrary stimuli through derived relations. In this case, words such as lean and heavy were directly trained to nonsense words, and the nonsense words to arbitrary images of vertical or horizontal lines. When later exposed to the Implicit Association Test (IAT), a response-latency based assessment tool that requires participants to rapidly categorize the congruency of paired stimuli, it was found that participants more quickly responded to pairs of stimuli that were consistent with the predicted relational frames. Therefore, the bias previously demonstrated toward obese-related stimuli was now shown, through implicit response,

toward the newly related stimuli of nonsense words and lines. This process may account for how individuals who were previously responded to without bias, may acquire negative stimulus functions when new relations emerge, i.e. middle-eastern individuals become objects of prejudice after association with terrorist attacks (see Dixon, Dymond, Rehfeldt, Roche, & Zlomke, 2003)

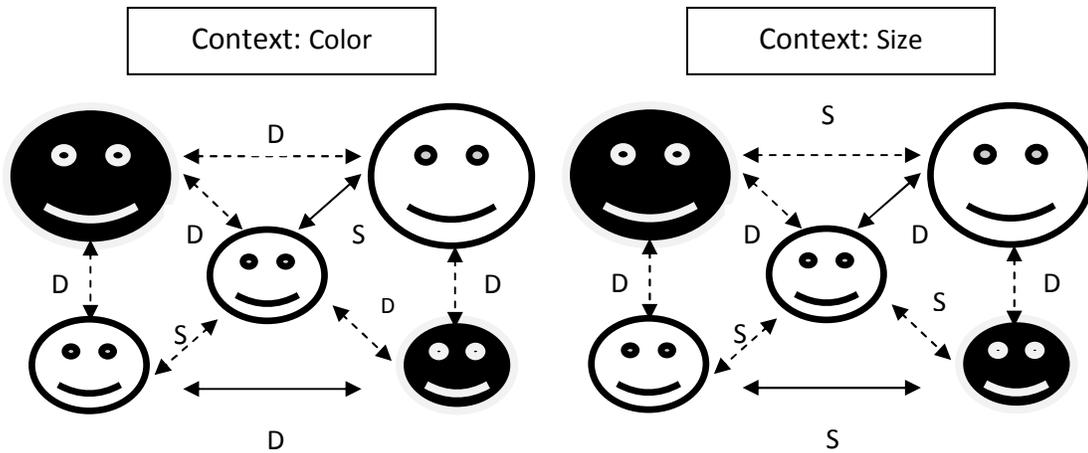


Figure 3. This figure diagrams two emerging conceptual groups (Black/White and Big/Little) from the perspective of the center face under the contextual control of either color or size. Note that in both cases, few directly trained relations are necessary to relate novel individuals.

Contextual control of relational responding can play a significant role in the transformation of bias related stimulus functions. For example, consider how the meaning of some words may differ when conditionally based on socially categorized groups. For example, the statement “He has been around the block” and “she has been around the block” may differ in connotation. In the case of the former, “he” may present a context in which “around the block” may relate to accomplishment or accolade, while in the case of the latter, “she” may present a context in which the same phrase may be pejorative. In a study by Kohlenberg, Hayes, and Hayes (1993), relational frames of coordination were trained under the contextual control of 3 male and 3 female names.

The resulting relational frames allowed for differential responding to stimuli, such that when a male name was present, A stimuli would be related to B, C, and D stimuli respectively, i.e. $A1=B1,C1,D1$. When a female name was present, the same A stimuli would still correspond to the same B stimuli, however would now correspond to a different C and D stimuli, i.e. $A1=B1,C3,D3$. Once such contextually controlled conditional discriminations were established, a test of contextual generalization was demonstrated by presenting novel male and female names as the context. Participants reliably responded to the aforementioned contextually controlled trials, suggesting that the context under which stimuli are related can be generalized when along pre-existing socially categorized relations. Kohlenberg, Hayes, and Hayes furthered these findings by assessing generalized contextual control of arbitrary stimuli through combinatorial relations. In this case, A-B and A-C relations were established for stimulus classes 1,2, and 3, followed by conditional discrimination trainings in which the B stimuli were used as the contextual cues, i.e. in the presence of B1, $A4=B4$ and $A4=C4$, however in the presence of B3, $A4=B4$ and $A4=C6$. When equivalence responding was assessed under the contextual control of the original C stimuli, the predicted relations consistent with the contextual control of B1, B2, and B3 were observed.

Relational frame theory thus suggests that derived, arbitrarily applicable, relational responding accounts for the formation of conceptualized groups and the emergent social prejudice based on the subsequent transformations of stimulus functions. As such, stimuli related to conceptualized groups can participate in new patterns of responding, both as the stimuli related and as the contextual cues under which other stimuli are perceived. However, if socially prejudice relational frames are constructed

through arbitrarily applicable relational responding, the same processes that lead to their establishment, should serve to dismantle them as well.

Dismantling Relational Frames of Prejudice

If relational framing, relating individuals with characteristics of conceptualized groups to negative functions, is the process by which patterns of prejudice are established then altering the relations between participating stimuli or affecting which functions are transformed should modify the pattern of prejudice (cf. Dixon, Dymond, Rehfeldt, Roche, Zlomke, 2003). However, this may be easier said than done.

Watt, Keene, Barnes, and Cairns (1991) attempted to dismantle relational responding to religious stimuli, by training Catholic Names to nonsense words (A-B relation), and nonsense words to Protestant symbols (A-C relation). Participant success in forming the expected combinatorial mutually entailed relations (B-C, C-B) was found to be related to the particular participants' ethnic background (English, Northern Irish Catholic, or Northern Irish Protestant). English and Northern Irish Protestants participants responded to stimuli according to expected combinatorial relation, however, Northern Irish Catholic participants failed to respond accordingly. Furthermore, when a novel Protestant symbol was introduced, only those participants that had appropriately responded to the combinatorial relations, succeeded in generalizing the experimental relational frame (Protestant symbols = Catholic Name). Similarly, difficulties were found when attempting to frame socially incongruent stimuli of male occupations and female names through direct training with a nonsense word (Moxon, Keenan, & Hine, 1993). Failure to form equivalence relations in both studies was attributed to the strength of pre-experimental stimulus functions. That is to say, those participants who have a long

history of reinforcement to responding in a culturally stereotypical manner are less likely to form new relations of coordination between stimuli previously learned as opposite (Watt, Keene, Barnes, & Cairns, 1991; Moxon, Keenan, & Hine, 1993).

In a study by Dixon, Rehfeldt, Zlomke, and Robinson (2006), the difficulties in forming new relational frames between pre-experimental culturally incongruent stimuli were further explored. Participants were given a pretest consisting of matching to sample trials in which words relating to the Middle-East (A), images of Terrorists (B), U.S.A. national symbols (C), images of a plane, camel, and World Trade Center (D) and images relating to American culture (E) were presented. The participants were then given sufficient training to form A-B and A-C relations. The participants were then administered a posttest. The results showed that before training, participants were most likely to respond to the conditional discriminations in a culturally congruent manner, i.e. matching American images to U.S. symbols and Terrorist images to Middle-Eastern words. During the posttest, participants were more likely to respond with the experimentally predicted, though culturally incongruent, B-C relations. However, responses to relations involving the D and E stimuli were still culturally stereotypical. This study demonstrated that programmed contingencies could to a degree over-ride the pre-existing relational frames, allowing for the construction of new frames of coordination. It was however noted that certain stimuli, were associated with a longer response latency during the training and posttest phases. It was suggested that these stimuli were more strongly associated with pre-existing relational frames. Therefore, a second study was designed to investigate which stimuli were more resistant to relational frame training. This study sought to form relational frames of coordination with sets of

neutral stimuli (flowers), Terrorist/Middle Eastern images (culturally congruent), and Terrorist/American images (culturally incongruent). It was found that participants required less training to reach criterion and were more quickly able to respond to Terrorist/Middle Eastern sets, than to the sets containing flowers or Terrorist/American images, suggesting that the Terrorist/Middle Eastern images were more likely to be participating in a pre-existing relational frame.

The previous studies sought to provide direct contingencies for the formation of a relational frame of coordination between the pre-experimental functions of stimuli. These attempts were met with limited success. This may have been due to pre-existing relations of opposition between the culturally stereotypical stimuli (i.e. Terrorist and American may be related as opposites). In term of transformation of stimulus functions, the previous studies would have transformed the functions of American and Terrorist stimuli to be similar. While this might inhibit the formation of new relations, the introduction of non-oppositional stimuli may increase the performance of participants to respond to the experimental functions of the stimuli. Dixon, Zlomke, and Refhedlt (2006) explored this possibility by first training A-B and A-C relations to form 3, 3 member relational networks of pre-experimentally inconsistent images, i.e. American to Terrorist. When participants failed to demonstrate the culturally inconsistent combinatorial relations (C-B), the words “Peace,” “Unity,” and “Resolve” were trained into coordination with the A stimuli (A-D relation). After the introduction of the D stimuli, correct responding to culturally inconsistent B-C relations rose relative to pre-testing. The authors argue that this increase in performance was the result of a transfer of stimulus function from the D stimuli across the entire relational network.

Difficulties in Dealing with Prejudice

It is not surprising that pre-experimental prejudicial relations, though their construction is easily modeled, are resistant to being dismantled in an experimental setting. Prejudice, as negative derived relations between an individual and a conceptualized group, is produced by the same verbal processes that allow for problem solving and reasoning (Hayes et al., 2002). Furthermore, once established, derived relations are likely to be generalized and re-emerge. Wilson and Hayes (1996) demonstrated this by training participants to respond in accordance with 3 equivalence classes consisting of 4 stimuli each. The participants were then trained to respond to those same stimuli in a different arrangement of equivalence classes. When later asked to respond to conditional discriminations in an extinction condition, the participants responded with the recently trained relations. However, when the participants were exposed to the same conditional discriminations in which the responses in accordance with the more recently trained relations produced feedback indicating an incorrect answer, the prior trained relations re-emerged. The participants continued to respond with the previously trained relations, even when under a condition of extinction. When applied to prejudice, the findings suggest that even when exposed to anti-prejudice instruction, the prior relations of prejudice may reemerge if the consequences maintaining the pro-active relations are removed or punished.

Common sense efforts and straightforward re-trainings of stimuli involved in stereotypes and prejudice are often ineffective and potentially counter-productive (Hayes, Barnes-Holmes, & Roche, 2001; Hayes et al., 2002). By simply identifying the conceptualized group during training, one may adventitiously reinforce the identification of such groups as well as add additional relations (Hayes et al., 2002 pg 203). It may be difficult to directly instruct against prejudice towards Arabs or women, if you cannot identify who women or Arabs are. In identifying them, you draw attention to the characteristic features that define the conceptualized group. In doing so, the instructed individual must engage in the relational responses necessary to recognize the group, so that new attributes may be related. For example, to understand the statement “men and women are equal,” you must identify the difference between what characterizes “men” and “women” before relating them as equal.

Even if identifying the stigmatized group is unavoidable, directly instructing against prejudice responses can result in further avoidance of group members. Langer, Fiske, Taylor, and Chanowitz (1976) hypothesized that when children are instructed not to stare at disabled individuals, the desire to stare at the novel disabled-individuals creates an aversive situation in which the children are forced to contend with their desire to stare and their desire to conform to proper manners. In one experiment designed to test this hypothesis, children were asked to interact with a disabled individual. Some children were allowed to observe disabled-individuals through a one-way mirror prior to interaction. The researchers found that children, who were asked to stare through the mirror, were more likely to approach and interact with the disabled individual than those children that had no opportunity to stare. Thus it is possible that many behavioral

contingencies designed to decrease prejudice may instead condition the presence of a disabled-individual into a conditioned aversive event, and through derived relational responding transform the function of other characteristics associated with disabilities.

Another difficulty in addressing prejudice is that even when equality is reflected in overt verbal behavior, such as answering questions about racism, prejudice in nonverbal behaviors may still be predicted and detected through measures of implicit responses, i.e. latency to respond to stereotypically inconsistent stimuli (Dovidio, Kawakami, Johnson, Johnson, & Howard, 1997; Dovidio et al., 2002; Heider & Austin, 2007; Rudman, Greenwald, Mellott, & Schwartz, 1999). For example, Heider and Austin (2007) asked Caucasian participants to complete a questionnaire rating Pro-Black/Anti-Black statements (PAAQ), followed by an IAT assessment in which white and black names were presented with pleasant or unpleasant words. Though participants generally responded to PAAQ statements neutrally, bias was noted on the IAT as indicated by longer response latencies when the same computer key was used to identify African names and pleasant stimuli or White names and unpleasant stimuli shared the same key. Participants were then asked to have two separate conversations with a white confederate and black confederate. Audio recordings (verbal behaviors) and video recordings (non-verbal behaviors) of the conversations were rated independently for behaviors relating to friendliness. Though no significant difference in friendliness was noted for scores based on audio conversations, scores based on the soundless videos suggested that participants were friendlier toward white confederates than black confederates.

Contextual Control in Implicit Responses

Implicit responses of prejudice and stereotyping, have been found to be sensitive to contextual features and stimulus cues (Blair 2002; Macrae, Bodenhausen, & Milne, 1995). In this case, the term implicit responses describes a response, or component response of a more complex response, that is unattended to by the organism, i.e. response-latencies, approach/avoidance proximities, etc.

Macrae and colleagues (1995) suggest that a given individual may be perceived as belonging to any number of conceptual groups; for example, a Chinese woman may be perceived as both a Chinese individual or as a woman. The particular category of relevance is determined by a number of factors, such as the relative accessibility or salience of the categorization, current processing goals, and the degree of prejudice toward a particular categorized group. It was further suggested that the cognitive mechanisms by which the relevant category is actualized are a combination of excitation and inhibitory processes. While the relevant categorization gains dominance as a result of the aforementioned factors, the irrelevant categorization is actively inhibited thus allowing the perceiver to ignore the irrelevant categorization.

This process was demonstrated through the application of a parafoveal priming during a vigilance task in which participants were asked to indicate the location of a flashing light that contained either the word woman or Chinese. The participants were then asked to rate the video quality of a 15-s clip of a Chinese woman reading a book. Participants then completed a single-word lexical decision task. In this procedure, the response latency to identify words as real or nonsense was measured for both nonsense words and for words stereotypically related to Chinese and woman. Unsurprisingly, participants identified words quicker when associated with the prime they were exposed

to; participants who were exposed to the prime of “Chinese,” identified words associated with Chinese stereotypes more quickly than those related to women, and those exposed to the prime of “Woman” more quickly identified words associated with woman than those associated with Chinese stereotypes. Furthermore, latency to identify nonsense words was found to be on average longer than identifying words related to the prime, but shorter for those words that were unrelated to the prime (Macrae, Bodenhausen, & Milne, 1995). The findings of this study support the hypothesis that particular prejudicial responding, when multiple categorizations are possible, may be predicted and influenced by contextual cues from implicit sources, i.e. priming.

Priming Effects Within Relational Frames

From a relational frame theory perspective, it is not surprising and indeed expected, that multiple conceptualized categorizations may be applied to a single individual, since any given stimulus may have multiple stimulus functions (c.f. Hayes, et al., 2001). Which categorization or relational frame is applied would then be determined by contextual cues, however, the extent to which these contextual cues may implicitly affect prejudicial relational responding is speculative.

Some implicit effects, such as priming effects, have been demonstrated within relational networks (Barnes-Holmes et al., 2004; Barnes-Holmes et al., 2005; Hayes & Bissett, 1998; Whelan, Cullinan, O’Donovan, Valverde, 2005). Priming is said to occur if a stimulus is more quickly identified when presentation of that stimulus is preceded by related stimuli. In the case of word stimuli, semantic priming occurs when the first word presented, or the prime, is semantically related to the second word or target. For example, if one was provided the stimulus word “Bread,” then the semantically related

word “Cake,” would be recognized more quickly than an unrelated word such as “Sky.” When the two words are related through usage rather than meaning, such as “Bread” and “Butter”, associative priming is said to occur. Mediated priming occurs when the target and prime stimuli are not directly related but rather indirectly related through another word. For example, the word “Stripes” may facilitate the recognition of the word “Lion,” not because a lion is related to stripes, but because both words are related to the word “Tiger” (Hayes & Bissett, 1998).

The presence of semantic, associative, and mediated priming effects within relational frames have been demonstrated using arbitrary word-like stimuli. Hayes and Bissett (1998) trained participants to form three 3-member equivalence classes using a matching-to-sample (MTS) procedure and supposed foreign words, (directly trained A to B and A to C relations, resulting in derived B-A, C-A, B-C, and C-B relations). After an equivalence test, in which participants were presented with MTS trials incorporating all possible relations, a two-word lexical decision task was administered. In this procedure, participants were presented with two words at a time, and asked to identify whether both words were real foreign words (those employed in the equivalence relations), or nonsense words. “Yes” responses were significantly faster for equivalence pairs than for nonequivalent pairs, despite the fact that both words were previously seen during training. Though pairs that were directly trained were the most quickly identified, pairs related by derived symmetrical and transitive relations did not differ significantly (Hayes & Bissett, 1998).

Barnes-Holmes and colleagues (2004) replicated the results of Hayes & Bissett (1998) by training participants to form two 4-member equivalence relational frames using

supposed foreign words. Participants were then exposed to a single-word lexical decision task, similar to that used by Macrae, Bodenhausen, and Milne, (1995), which is the most common priming procedure (see Neely, 1991). Again, words were more quickly identified as “real foreign words,” when words from their respective equivalence classes were presented prior as prime stimuli. In order to rule out the possibility of episodic priming, priming between unrelated words that were previously presented in temporal proximity, a second replication was conducted in which the equivalence test was presented after the lexical decision task. However, unlike the previous replication, in which participants who failed the equivalence test were recycled back into the training phases, not all participants demonstrated the equivalence relations in the post lexical decision task test of equivalence. For those participants who did pass the equivalence test, shorter response latencies to identify words when primed by class related words were observed. However, participants who did not pass the equivalence test, displayed no significant difference in response latencies. This result suggests that semantic and mediated priming effects are only present between relationally framed stimuli, when derived relations have emerged. Further replications of semantic and mediated priming within, but not across, equivalence classes was observed during single and two word lexical decision tasks, using both response latencies and event-related potentials (Barnes-Holmes et al., 2004; Barnes-Holmes et al., 2005).

As noted earlier, relational frame theory considers equivalence relations to be only one type of relational frame. Associative priming, in which words are primed by words that are not semantically equivalent but rather related by some other relationship, such as common exposure or opposition, has been demonstrated within relational frame

theory literature. Whelan, Cullin, O'Donovan, & Rodriguez Valverde (2005) demonstrated that participants who had received MTS training sufficient to produce a relational network consisting of 5 stimuli and the relations of same and opposite. In this case, where the context is given in capitals, and sample in italics followed by correct trained relations, the stimuli A1 was trained in the following contextual relations; SAME/*A1-B1,C1* and OPPOSITE/*A1-B2,C2*. Based on this training, the following relations would emerge; SAME/*B1-A1,C1*, SAME/*C1-A1,B1*, OPPOSITE/*B1-B2,C2*, OPPOSITE/*C1-B2,C2*, SAME/*B2-C2*, SAME/*C2-B2*, OPPOSITE/*B2-A1,B1,C1*, and OPPOSITE/*C1-A1,B1,C2*. Participants were then exposed to a two-word lexical decision task. Results of this study indicated that participants more quickly identified supposed foreign words more quickly than none-sense words, when the foreign word was primed by word related through either frame of coordination (same) or opposition. The presence of priming effects between prime and target words that are related through frames of opposition suggests associative priming, as the words cannot be said to be semantically related. No significant difference in response latency between semantic, mediated, or associative priming was detected (Whelan et al., 2005).

The Need for Implicit Contextual Cues in a RFT Account of Prejudice

Though relational frame theory has demonstrated a possible etiological account for the formation of semantic, mediated, and associative relations, the lack of contextual cues within these demonstrations presents a limitation. As noted by Macrae, Bodenhausen, and Milne (1995), dynamic excitation and inhibitory processes as initiated by implicit stimulus cues may result in the dominance of one conceptual categorization over another, despite the possibility of both categorizations. From a relational frame

theory perspective, contextual cues occasion the particular frame and affect which function is to be applied. To this extent, it would be expected that without contextual cues, all possible relations would be equally likely (Hayes et al., 2001). In the lexical decision task employed by Whalen and colleagues (2005), no contextual cue was presented, despite the necessity of the contextual cues to produce same and opposite relations during training. The inclusion of contextual cues within the lexical decision task may increase differentiation between response latencies with respect to semantic and associative priming, and thus provide a behavior analytic account for why particular primed categorizations may be more likely when others are possible.

The same limitation may also account for some of the difficulties seen in dismantling pre-experimental culturally stereotypical relational frames. For example, when a participant has been trained to match a particular American Image to a particular Arab image without the use of contextual cues, it is assumed that when the same frame and function that was applied to those two stimuli will be employed by the participant when presented with novel Arab stimuli. However, this may not be the case. Suppose a participant is provided sufficient contextual cues to occasion a relational frame of “same” and a function of “in peace talks”; the participant may now be more likely to select culturally stereotypical Arab images as comparisons to American samples, as both are frequently in peace talks. This result may have been the case when Dixon, Zlomke, and Rehfeldt (2006) introduced the stimuli words “Peace”, “Unity”, and “Resolve”. Though the researchers suggested that the pre-experimental functions of these words once included in culturally inconsistent relational frames, transformed the stimulus functions of the participating stimuli so as to more readily allow for participation in a frame of

coordination, another possible explanation is that the inclusion of the peace oriented words served as an implicit contextual cue for participants to select stimuli based on a different function. A similar effect has been noted in priming literature, where by priming words such as “Loyalty” or “Equality” may increase or decrease expressions of intergroup bias (Zogmaister, Arcuri, Castelli, & Smith, 2008). However, the influence of contextual cues in implicit processes and the role of priming as a contextual cue have not been demonstrated within the relational frame theory literature.

The present study sought to address this issue by providing participants adequate training to form four contextually controlled 3-member equivalence classes. Once established, the participants were asked to complete a single-word lexical decision-making task in which prime/target pairs were presented both with and without the contextual cues used during training. The purpose of the study was to demonstrate the role of contextual cues over the transformation of stimulus functions with respect to semantic and mediated priming. More specifically, the study sought to demonstrate that response latencies to identify words when preceded by a prime word, related only through a derived relation, will vary when the primed also includes relevant contextual cues.

It should be noted that though this study is a basic research experiment using arbitrary word-like stimuli and therefore limited in terms of generalization to the phenomenon of prejudice, understanding the influence of an operant history over implicit responding may lead to a more precise methodology for dismantling prejudice. Implicit contextual cues, such as priming, may be momentary with regards to the duration of their effect; however, the ability to increase the probability of one form of relational response

over another may be invaluable. Such processes may already be utilized within behavior interventions in the form of prompting. By providing a partial verbal or visual prompt, behavior therapists seek to increase the probability of a perceptual or semantically related response. This is not unlike priming, in which the presentation of related stimuli increases the probability of responses to related target stimuli. As dismantling prejudice is difficult to achieve without directly addressing the prejudicial characteristics involved, using contextual cues to create a novel relation between culturally incongruent stimuli and then adding those same contextual cues to the environment in which prejudicial responses are likely, may allow for an operant based method for prompting non-prejudicial relations.

Method

Participants

21 participants were recruited for this study. Participants were individuals recruited from a large South-Eastern University. Recruitment methods included a flyer advertisement placed in high trafficked campus locations. Criterion for participation was determined by review of a recruitment application (see appendix 1), which required indication the language spoken at home. Due to the stimuli words having been designed to appear as real foreign words to an English speaker, the primary inclusion criteria required participants to indicate that English is the language spoken at their home. In order to enhance attending to tasks, the participants received compensation commensurate with the completion of each of the two experimental phases; \$7.50 for each phase, amounting to \$15 total delivered as a gift card to a nationally franchised general store. Participants were informed that their performance on each phase would determine the amount of compensation they were to receive; however, participants received full compensation for successful completion (as defined below) of each phase. This deception was made in order to motivate participants to continue attending to experimental tasks when no feedback was provided by the test apparatus. All compensation was provided when participants completed their last phase of the study.

Apparatus and Setting

Sessions were conducted individually in a small office, approx. 7'x10'.

Participants were seated at a desk with a color monitor, keyboard, and mouse device behind which was a blank wall. These devices were attached to a computer that was inaccessible to the participant. Presentation of instructions and task-related stimuli were presented on the monitor and all trial selection and response measurements were controlled and recorded by the computer (running Mac OSX). Participant responses were indicated using the mouse and keyboard devices. A research assistant was seated behind the participant throughout the session so as to facilitate the operation of the apparatus; however he/she did not provide instruction, feedback, or assistance to the participant. Participants were asked to leave their cellphones turned off before entering the experimental setting.

Stimuli

Twenty-six arbitrary word-like stimuli were used. These stimuli were drawn from Whalen et al. (2005), see appendix 2. All word-like stimuli consisted of 6 letters and met the following criteria; a) were orthographically regular; b) were pronounceable; c) contained common vowel and consonant spellings; and d) had no more than three letters for a medial consonant cluster if one occurred. For each participant, 15 stimuli were randomly assigned: 6 to be trained in 4 contextually controlled relational frames; 3 to serve as non-word comparisons, and 6 to serve as control stimuli. These stimuli were assigned randomly and recorded by the following alphanumeric labels; A1, A2, B1, B2, C1, C2, N1, N2, N3, N4, N5, N6, N7, N8, and N9. All presentations of word-like stimuli were in a black Helvetica font, 14 size. Contextual stimuli were presented as either a blue (ox 0000ff) and a red (ox ff0000) background and were randomly assigned

for each participant as CS1 and CS2. In the final stage a grey background (grey scale .6, alpha 1.0) was utilized to constitute a context ambiguous condition, referred to as CS^{absent}.

General Experimental Sequence

The experiment consisted of two phases. Phase 1 consisted of a series of conditional discrimination trials necessary to establish 4 contextually controlled relational frames: 2 under CS1 and 2 under CS2. Phase 2 utilized a single stimulus lexical decision task, with the addition of contextual stimuli, in order to ascertain the effect on response latency for identifying target words under the conditions of being primed by semantically related, semantically unrelated, and non-words.

Below you will find an ordering of the training and testing sequence including the relations trained, trials per block, and mastery criterion for each step. Note that all matching-to-sample training steps allowed for up to ten trial blocks for participants to meet criterion.

Phase 1: Establish 4 contextually controlled 3-member equivalence class

MTS – Context, 1.5s delay, Sample, 1.5s delay,

Step 1: Train A-B relations under both contexts (CS1,CS2) Mastery Criterion

Step1A: CS1(A1-B1, A2-B2) 10 trials 2 blocks at 9/10

Step1B: CS2(A1-B1, A2-B2) 10 trials 2 blocks at 9/10

Step1C: Mixed training 12 trials 2 blocks at 11/12

Step 2: Train A-C relations under both contexts (CS1,CS2)

Step2A: CS1(A1-C1, A2-C2) 10 trials 2 blocks at 9/10

Step2B: CS2(A1-C2, A2-C1) 10 trials 2 blocks at 9/10

Step2C: Mixed Training 12 trials 2 blocks at 11/12

Step 3: Grand Mix Training

CS1(A1-B1, A2-B2)

CS2(A1-B1, A2-B2)

CS1(A1-C1, A2-C2)

CS2(A1-C2, A2-C1) 24 trials 2 blocks at 22/24

Phase 2: Priming Test (Single Stimulus Lexical Decision Task)

Step 5: Train use of lexical decision task

English words with feedback 24 trials

Step 6: Test all prime/targets relations in all contexts.

CS1, P: A1, T: B1, C1, A2, B2, C2, N4, N5, N6, N7, N8, N9

CS2, P: A1, T: B1, C1, A2, B2, C2, N4, N5, N6, N7, N8, N9

CSabsent, P: A1, T: B1, C1, A2, B2, C2, N4, N5, N6, N7, N8, N9

LDT: Prime: 500ms

Delay: 200ms

Target: 2000

Inter-trial Time: 2000

Procedure

Phase 1. Establishment of 4 contextually controlled relational frames. A 3 part series of matching to sample tasks was used to train and test the establishment of 4 contextually controlled relational frames using a sample as node arrangement.

Instructions were delivered to participants via the computer screen, see appendix 3.

For each trial, the sample appeared in a box, centered in the top half of the screen. The appropriate contextual background was presented at the same time as the

sample stimulus encompassed the screen. After a 2 second delay, three comparison stimuli were presented in boxes, evenly spaced in the lower half of the screen.

Subjects selected a comparison stimulus by moving the mouse cursor over a comparison and clicking the mouse button. The box of the selected comparison required a double click to confirm selection. Once a comparison was selected, the sample and comparisons were removed from the screen and feedback presented. The words “Correct” or “Incorrect” appeared centered in the middle of the screen, along with a series of ascending or descending tones, respectively. After 1s, the feedback stimulus was removed and the instruction to “click anywhere,” prompted the participant to click for the next trial. If no comparison was selected after 3 seconds, the “Incorrect” feedback was presented and the trial scored as no response.

Step 1: A-B relations under contextual control. The first series of matching to sample trials, trained for the selection of B1 and B2 as comparison stimuli in the presence of A1 and A2 sample stimuli respectively, under the context of CS1. This would result in the following relations; (CS1) A1-B1, (CS1)A2-B2.

Step 1a. Across a 10 trial block (5 trials for each A stimulus, in a random sequence,) A1 or A2 were presented as the sample with the corresponding CS1 background. After the 1s delay, B1, B2 and a random none-word (N1, N2, N3) stimuli were presented as comparisons. Selection of B1 in the presence of A1, and B2 in the presence of A2, was followed with the stimuli designating a “Correct” response, while selection of B2 in the presence A1, and B1 in the presence of A2 or the none-word stimulus was followed by the stimuli designating an “incorrect” response. If mastery criterion was not met, 90% or better correct across two consecutive trial blocks, the

participant repeated above sequence. Participants were permitted a total of 10 trial blocks, after which failure to meet mastery criterion resulted in that participant being excused from further participation.

Step 1b. If mastery criterion was met, the participant was then presented a 10 trial-block of matching to sample trials in which the selection of B1 and B2 comparison stimuli were reinforced in the presence of A1 and A2 sample stimuli respectively, under the context of CS2. As with the previous sequence, each A stimulus sample was presented 5 times, resulting in 10 trials. The resulting relations can be described as (CS2)A1-B1 and (CS2)A2-B2.

Step 1c. If the 90% criterion was met for step 1b, the participant continued to a mixed training block of the A-B relations under both CS1 and CS2 contexts. Each contextually controlled A-B relation was presented a total of 3 times for a total of 12 trials. Participants meeting criteria for the mixed training block continue to step 2, while those failing to meet criteria repeated the mixed training up to 10 trial blocks.

Step 2: A-C relations under contextual control. The procedures of step 2 were similar to those of step 1; however C1 and C2 stimuli were trained instead of B1 and B2. Additionally, under the context background of CS2, the selection of C2 was reinforced in the presence of A1 and C1 in the presence of A2. The resulting relations can be described as (CS1)A1-C1, (CS1)A2-C2, (CS2)A1-C2, (CS2)A2-C1.

Step 3: Grand mixed review of A-B, A-C relations under contextual control. Step 3 was a 24 trial block, consisting of 3 presentations of all A-B and A-C relations. The block was repeated until 90% mastery criterion was met. Upon meeting criteria, participants progressed to phase 2. Participants who failed to progress to phase 2 but

completed phase 1, were informed that they had completed the study and were provided compensation.

At no point during Phase 1 were B-A or B-C relations directly trained. Participants were offered a 5 minute break between Phase 1 and Phase 2. Participants were permitted access to bottled water, the restroom, and a smoking area. Participants were not allowed to communicate with other participants should they be present, or to speak with the researchers about the study. After the break the participants were prompted to return to the computer.

Phase 2. Testing for Contextually Controlled Semantic and Mediated Priming. In order to evaluate the role of contextual variables in the identification of semantically primed derived relational stimuli, a single word lexical decision task was implemented. The procedure used was similar to that of Barnes-Holmes et al., (2005), as it had been used to demonstrate the presence of semantic priming effects with derived stimulus relations and is the among most common priming paradigm employed. The procedure employed by Barnes-Holmes et al., began with each trial presenting a large red “X” in the middle of the screen. After 500ms the red “X” was removed and replaced with a prime stimulus. After 200ms the prime was removed and followed by a 50ms delay, followed by the target stimulus. The target stimulus remained on screen for 1,500ms, at which time the target was removed and replaced with a green “X.” After 1,250ms, the green “X” was removed and the next trial began. No indication of correct or incorrect response was provided. The procedure utilized in this study is identical to that described above, with an exception that the target stimulus was available up to 2000ms, inter-trial times were 2000ms, and instead of a blank white background through-out the procedure, trials

including the contextual background stimuli, CS1 and CS2, were presented in addition to trials with a plain grey background.

Phase 2: Training. Participants began phase 2 with a short training sequence on the use of the single word lexical decision task. Instructions were delivered via the computer monitor, see appendix 4. A block of 24 trials were presented using common English words. Instructions were delivered via the computer and instructed participants rest their hands on the “Z” and “M” keys of a keyboard. They were then instructed to mentally read the prime stimulus word and then to use the key “Z” to indicate whether a target word is an English word and to use the “M” key to indicate that it is a foreign word. Emphasis was made on responding as quickly as possible and to only respond to the target stimulus word. Participants were informed that responses after the green “X” appears will not be recorded and that their compensation is related to their performance.

Phase 2: Testing for derived semantic priming. After the training sequence was completed, the participants were presented with a series of single-word lexical decision tasks with the additional contextual stimuli. They were instructed to indicate as quickly as possible if, “Yes” the target is a real foreign word (i.e. one presented in Phase 1), or “No” it is not a real foreign word, (i.e. not presented in phase 1). Each experimentally relevant stimulus was presented as a prime/target pair twice with every other stimulus, under CS1, CS2, and CS^{absent} contexts. Additionally, the 6 previously unseen non-sense words (N4, N5, N6, N7, N8, N9) were randomly selected and presented as both prime and targets with the previously presented stimuli. The resulting 486 pairs, 162 in each context condition, were arranged in two trial blocks, in which each pair was presented only once in each block. Pairs involving N stimuli were quasi-randomly assigned equally

to either block. A 2 minute break was allowed between each 243 trial blocks. Within each trial block the pairs were presented in a random order. Indicating “Z” to a target word that was present in phase 1 was recorded as correct, while indicating “M” was considered incorrect. Indicating “Z” to a target word that was not present in phase 1 was recorded as incorrect, while indicating “M” was recorded as correct. Response latencies to identify the target word as “Z” or “M” were recorded in milliseconds from the presentation of target stimulus to the depression of an indication key. Failure to respond before the green “X” appears was recorded as No response.

Results

A total of 21 subjects participated in this study. Due to a change in experimental parameters after initial testing, participant 1's data was excluded from the final analysis. As a result of technical difficulties resulting in a corruption of experimental data, data from participants 6-14 could not be retrieved and is therefore not included in the final analysis. Of the remaining 11 participants, 10 participants successfully completed both phases of the experiment. Participant 18 failed to reach mastery criteria during the grand mixed review of phase 1 and thus produced no LDT data for analysis. Of the 10 participants who completed the LDT, 2 were male and 8 female with ages ranging from 18 to 27 ($M=21.2$, $SD=3.42$).

Individual Data

During the matching-to-sample training (phase 1), Participants 2-5, 15-17, and 18-21 reached mastery criterion and required between 16-30 trial blocks. See table 1 for blocks to criterion for individual participants.

During the second phase of the experiment, participants were asked to respond to a series of 486 prime/target trials. A correct response was recorded when a participant indicated that a word, previously seen in phase 1, was a real foreign word by pressing the "Z" key or when the participant indicated that a word not previously seen was not real by pressing the "M" key. Conversely, indicating "Z" to a non-word and "M" to a real-word was recorded as incorrect. Response latencies for incorrect responses, no response, or

outliers (response latencies exceeding 2 standard deviations from the individual’s mean response latencies, approx. 4% of valid correct responses) were not included in the final analysis. See Table 2 for individual participant accuracy during the LDT phase.

Table 1: *Number of Blocks to Criterion by Participant*

Step of Phase 1	Participant									
	Part 2	Part 3	Part 4	Part 5	Part 15	Part 16	Part 17	Part 19	Part 20	Part 21
CS1 - A=B	3	2	4	3	3	3	2	3	3	2
CS2 - A=B	2	2	2	2	2	2	2	2	2	2
CS1/CS2 - A=B	2	2	2	2	2	2	2	2	2	2
CS1 - A=C	2	5	3	2	3	2	3	3	3	2
CS2 - A=C	3	3	5	3	3	3	3	4	3	3
CS1/CS2 - A=C	7	3	7	3	4	3	2	3	7	5
CS1/CS2 - A=B/A=C	3	4	7	2	4	2	2	4	8	2
Total Blocks Required	22	21	30	17	21	17	16	21	28	18

Note. This table displays the number of blocks to criterion required by participant. Steps are described here by the context, relations trained, and represent the steps in the order presented. Criterion for each step of phase 1 was defined as 2 consecutive blocks at 90% or higher. Therefore, a minimum of 2 blocks was required per step and a minimum of 14 blocks to complete phases 1.

Table 2: *Percent of LDT Trials Correct by Participant*

Percent Correct	Participant									
	Part 2	Part 3	Part 4	Part 5	Part 15	Part 16	Part 17	Part 19	Part 20	Part 21
Percent Correct	96	71	77	99	91	91	47	99	67	98

Note: While no exclusion criterion was established for percent of trials correct, a low percent of trials correct may indicate that a participant was not attending to the experimental task, misunderstood the directions, or was attempting to answer too quickly.

In the following analysis of data, mean response latencies are organized into several comparisons based on the relation shared between the prime and target stimuli. The following categories are described as either being related or unrelated, contextually related or contextually unrelated, and as consisting of experimental or neutral stimuli.

Additionally, categories are differentiated as to whether the relation was directly trained or the result of a mutual or combinatorial entailment. Prime/target pairs were considered “Related” if both stimuli participated one of the frames of coordination previously described. Pairs were considered unrelated if they included a neutral stimulus, or if both stimuli did not participate in one of the previously described frames of coordination. For a pair to be considered contextually related, both stimuli must participate in an appropriate frame of coordination for the contextual stimulus. For example, under the CS1 background, B1 and C1 may be considered contextually related, however, under the CS2 background, the same stimuli would be considered contextually unrelated. Prime/Target pairs are also described as being experimental or neutral. In order to differentiate between comparisons of all stimuli, experimental and neutral combined, some categories include an indication of whether the prime or target was a stimulus present in the matching-to-sample training. This designation is particularly important in addressing issues of episodic priming or the presence of a priming effect simply because stimuli were present close together in time. See table 3 for the mean response latencies for each individual by category.

The presence of a priming effect is indicated by shorter mean response latencies when responding to related prime/target pairs compared to unrelated or neutral pairs. Participants 2, 3, 4, 5, 15, 16 and 21 presented relatively shorter response latencies to related pairs compared to unrelated pairs consisting of both experimental stimuli and neutral stimuli. Participants 17, 19, and 20 presented longer response latencies for related pairs. However, response latencies between related pairs and unrelated pairs consisting of only experimental stimuli (Exp. Unrelated) were nearly undifferentiated (average

response latencies within 10ms) for participants 2, 4, 5, 15, 17, and 21. Participants 3, 16, 20, and 21 presented a greater differentiation between related and exp. unrelated pairs, in which response latencies to related pairs were shorter. Participant 19 presented the greatest differentiation between related and exp. unrelated pairs, however, this participant presented shorter response latencies to exp. unrelated pairs. For all participants with the exception of participant 17, 19, and 20, related pairs resulted in shorter average responses latencies than for pairs involving a neutral prime and experimental target; this finding is indicative of an episodic priming effect.

Comparisons between contextually related and contextually unrelated pairs consisting only of experimental stimuli (Exp. CS Unrelated), were somewhat more differentiated. Participants 3 and 5 presented average response latencies with less than 10ms differentiation for CS related and Exp. CS unrelated pairs. Participant 4, 15, 16, 20, and 21 presented shorter response latencies for contextually related stimuli than for exp. contextually unrelated pairs. Participants 2, 17, and 19 presented longer average response latencies for contextually related pairs. Shorter average response latencies for CS related pairs compared to exp. CS unrelated pairs are indicative of a contextually sensitive priming effect.

Mean Data

The following data represents the mean response latencies across participants for all participants who completed the LDT phase. Mean response latencies were again organized into categories describing the relation, contextual relevance, experimental function, and relational characteristic of the prime/target pairs. See Figure 4 and Table 4 for the mean response latencies across-participants by category.

Table 3: Mean Response Latency for Individuals by Categories

Category	Participant Average Response Latencies (ms)									
	Part 2	Part 3	Part 4	Part 5	Part 15	Part 16	Part 17	Part 19	Part 20	Part 21
Related	609	683*	747	524	570	563*	625	844	776*	773*
Unrelated	636	726	784	548	659	631	623	813	728	862
Exp. Unrelated	610	741	743	526	576	583	619	783	799	791
CS Related	636	697	732*	528	562*	561*	637	833	772*	758*
Exp. CS Unrelated	597	702	751	523	582	576	610	819	784	787
CS Related	628	717	779	544	643	619	621	820	733	848
Direct	594	739	741	522	567	545	652	867	822	741
Direct CS Related	623	774	759	528	571	531	643	816	811	745
Direct CS Unrelated	573	717	731	518	565	554	658	898	826	739
Mutual	638	649	747	525	551	531	609	797	716	785
Mut. CS Related	638	644	728	529	531	530	612	792	661	805
Mut. CS Unrelated	645	652	733	540	555	537	600	819	814	711
Comb. Related	598	668	751	525	586	597	615	862	784	787
Comb. CS Related	580	676	767	528	576	599	643	827	795	787
Comb. CS Unrelated	610	593	702	533	628	611	572	838	739	827
Neutral - Exp	628	696	752	533	651	626	601	810	801	876
Exp - Neutral	660	736	805	560	702	665	726	840	706	891
Neutral - Neutral	639	745	849	569	678	624	726	806	699	858

*Note: Table 3 displays the mean response latencies for each participant by category. The abbreviation exp. designates a category in which the pairs consisted of only experimental stimuli. The abbreviation CS indicates whether the pairs were contextually related. The abbreviation Mut. indicates pairs that share a mutually entailed relation. The abbreviation Comb. indicates pairs that shared a combinatorial relation. The final three categories indicate whether the prime and target were experimental or neutral stimuli, as designated by their position (prime-target). * indicates a negative differentiation greater than 10ms (possible priming effect) between related and exp. unrelated or between CS related and Exp. CS Unrelated, respectively.*

Comparisons between mean response latencies by categories were completed using dependent Student's T-Tests. Results of evaluations of the assumptions of normality of sample distributions and linearity were satisfactory. See Table 5 for the results of mean comparisons.

Results at the group level were similar to the results at the individual level.

Response Latencies to related pairs (M=671ms, SE=34.4) were on average faster than

those of unrelated pairs ($M=701$, $SE=31.1$), however were not sufficiently differentiated to meet statistical significance ($t(9) = -2.01$, $p<0.075$) (Comparison 1). This

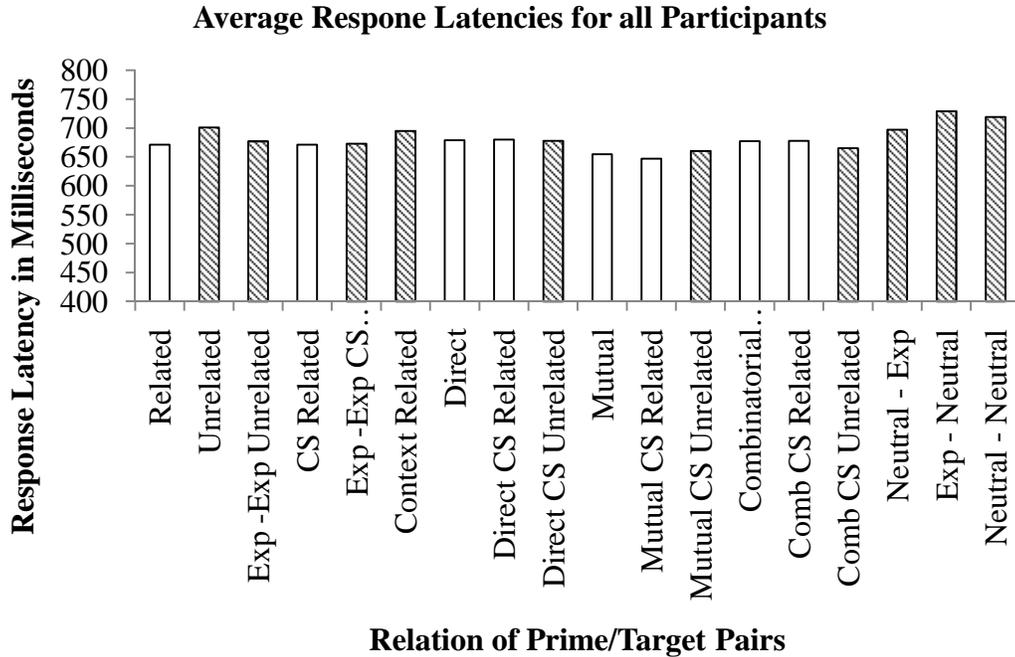


Figure 4. This figure displays the Average Response Latency Across-Participants by category. Open columns indicate a category in which prime/target pairs are expected to produce shorter response latencies due to an appropriate relation or learning history. Shaded columns indicate a category in which prime/target pairs are expected to produce longer response latencies due to a lack of learning history that would have produced a relation between stimuli or due to an a contextually incongruent relation. The presence of a priming effect would be indicated by shorter response latencies for related (open) columns in comparison to unrelated (shaded) columns.

differentiation become less pronounced when comparing response latencies to related pairs with those of unrelated pairs consisting only of experimental stimuli ($M=677$, $SE=32.9$), ($t(9) = -0.618$, $p<0.552$) (Comparison 2). Comparisons 7, 8, and 9 compare related pairs to pairs containing at least one neutral stimulus. These comparisons are used to evaluate whether a priming effect is the result of a specific learning history or due to temporally proximal exposure to the experimental stimuli. Comparison 7, while failing to meet significance at the .05 level, suggests that response latencies to correctly

identifying the function of target word were generally faster when preceded by a related stimulus. Related pairs were significantly faster than those of neutral pairs or pairs consisting of an experimental prime and neutral target.

Table 4: *Mean Response Latencies Across-Participants By Category*

Category	Average Response Latency (ms)	Standard Error of Mean (SEM)
Related	671	34
Unrelated	701	31
Exp -Exp Unrelated	677	33
CS Related	671	33
Exp -Exp CS Unrelated	673	34
Context Unrelated	695	31
Direct	679	38
Direct CS Related	680	36
Direct CS Unrelated	678	40
Mutual	655	32
Mutual CS Related	647	32
Mutual CS Unrelated	661	34
Combinatorial Related	677	35
Comb CS Related	678	34
Comb CS Unrelated	665	34
Neutral - Exp	697	34
Exp - Neutral	729	30
Neutral - Neutral	719	31

Note: Table 4 displays the mean response latencies for each participant by category. The abbreviation exp. designates a category in which the pairs consisted of only experimental stimuli. The abbreviation CS indicates whether the pairs were contextually related. The abbreviation Mut. indicates pairs that share a mutually entailed relation. The abbreviation Comb. indicates pairs that shared a combinatorial relation. The final three categories indicate whether the prime and target were experimental or neutral stimuli, as designated by their position (prime-target).

Comparisons between categories of relation characteristics approached statistical significance, however, failed to meet the .05 criterion. Pairs involving mutually entailed words (M=654, SE=32.4) yielded generally faster response latencies than those involving

directly trained (M=679, SE=38.1) and combinatorial relations ((M=677, SE=35.2), (Comparisons 10, 11, & 12).

Table 5: Results of Comparisons of Mean Response Latencies between Categories

Comparison #	Categories		Significance Level (2-Tailed)
1**	Related	Unrelated	0.075
2**	Related	Exp -Exp Unrelated	0.552
3**	Context Related	Exp -Exp CS Unrelated	0.816
4	Direct CS Related	Direct CS Unrelated	0.881
5**	Mutual CS Related	Mutual CS Unrelated	0.492
6	Comb CS Related	Comb CS Unrelated	0.458
7**	Related	Neutral - Exp	0.092
8**	Related	Exp - Neutral	0.015*
9**	Related	Neutral - Neutral	0.037*
10	Direct	Mutual	0.152
11	Direct	Combinatorial	0.179
12	Mutual	Combinatorial	0.076

Note: * signifies a significant differentiation between means at the 0.5 level. Using the Student's Dependent T-Test procedure. ** Indicates a negative difference between means, indicating the possibility of a priming effect.

Of primary interest to this study, the comparison between contextually related pairs (M=671, SE=32.5) and contextually unrelated pairs consisting only of experimental stimuli (M=673, SE=33.9) showed little differentiation between response latencies ($t(9)=-0.240, p<0.816$). This finding was consistent when individual contexts were assessed. Under CS1, contextually related pairs (M=693, SE=36.6) were undifferentiated from contextually unrelated pairs (M=688, SE=37.0) ($t(9)=0.322, p<0.755$). Under CS2, contextually related pairs (M=688, SE=45) were more differentiated from contextually unrelated pairs (M=663, SE=32) ($t(9)=1.222, p<0.253$), however, failed to meet statistical significance. The CS^{absent} condition did not yield contextually related pairs as the context was made purposefully ambiguous.

Discussion

The current study failed to demonstrate contextually controlled priming effects within related stimuli using a single-word lexical decision task. However, the procedures utilized in this study did produce response latencies that were generally shorter for related stimuli than for pairs consisting of neutral primes and experimental targets. This result is indicative of an episodic priming effect, in which stimuli with no pre-experimental functions became associated through the experimental procedure. Evidence suggestive of semantic, associative, and mediated priming was limited by the lack of differentiation between response latencies to related pairs and pairs consisting of unrelated experimental stimuli (Exp. Unrelated Pairs). Furthermore, contextually controlled priming was unsubstantiated by the similarity in responding to contextually related pairs and contextually unrelated pairs.

Several factors may have contributed to the lack in variation in the above comparisons. While matching-to-sample preparations have previously been used to train semantic relations resulting in demonstrated priming effects between members of relational networks (Barnes-Holmes et al., 2004; Barnes-Holmes et al., 2005; Hayes & Bissett, 1998; Whalen et al., 2005), the multiple and simultaneous presentations of experimental stimuli may still lead to the afore-mentioned presence of episodic priming. Due to the number of stimuli and complexity of training 4 contextually controlled relational networks, each word-like stimulus was present in a minimum of 88 trials

during the MTS training (phase 1). As such, it is possible for associations to emerge between stimuli that were not the result of direct training or derived relational responding. For example, in each stage of the training, a sample A stimulus was presented in the presence of two B or C stimuli along with a control word (N1-3). After a number of exposures to this training, it could be expected for a participant to come to associate the two B or C comparisons with each other due to the consistent simultaneous presentation of the two word-like stimuli. Such an association would not be detectable during the MTS training as the presentation of B or C stimuli as samples was purposefully avoided in order to reduce confounding the formation of derived relations. An association between the comparison stimuli, B1 to B2 and C1 to C2, could potentially give rise to an episodic priming effect which would produce response latencies similar to those expected from semantic relations. Therefore, the presence of such episodic priming effects may have diminished the detectability of semantic priming effects. Inclusion of the N1-3 stimuli in the LDT testing phase would have provided a means for evaluating if an episodic association was produced due to the repeated simultaneous presentation of stimuli. However, N1-3 stimuli were randomly presented as comparisons and therefore no particular N stimuli were consistently presented with either B or C comparisons. Future replications of this experimental procedure should include N stimuli that are consistently presented with B/C stimuli during MTS training and the further evaluation of these N stimuli as primes and targets during the LDT phase.

Another potential factor leading to the appearance of episodic priming in this study was the inter-related nature of the relational networks constructed. The training phase implemented was designed to produce responding in accordance with four 3-

member relational networks. As purposed by the use of contextual controls, the stimuli of these networks were not mutually exclusive; some stimuli were present in multiple networks. As a result, derived relational responding may have occurred between stimuli that were more than one nodal distance apart. In other words, through the process of derived relational responding, participants may have related all stimuli to each other. See Figure 5 for a diagram of these possible relations. In such a case, results resembling episodic priming could be expected. Previous research evaluating priming in relational networks did not find that response latencies differed significantly as a function of nodal distance (Hayes & Bissett, 1998; Whelan et al., 2005). However, these studies did not evaluate response latencies beyond 1 nodal distance. As no derived relation evaluation was utilized in the present study, it is difficult to determine if the appearance of an episodic priming effect was the result a merger of all classes or simply due to the presence of the stimuli in the earlier training phase.

As the methodology employed in this study differed in several ways from previous research, caution should be exercised when comparing these results. One distinction from previous research was the lack of feedback during the LDT phase. The lexical decision tasks utilized by Hayes and Bissett (1998) and Whelan and colleagues (2005) provided the words “Correct” and “Wrong” after responses. In the present study, participants received no feedback across the 486 trials. While error-rates were reasonable low (median=91% correct), corrective feedback of the type used in earlier research may have maintained participant motivation and reinforced not only accurate but rapid responding. However, corrective feedback was cited in both previous studies as a potential limitation due to the possibility of such feedback adventitiously reinforcing

derived relations. LDT procedures utilized by Barnes-Holmes and colleagues (2005) demonstrated semantic priming in the absence of corrective feedback. Due to the repetitive nature and numerous trials of the lexical-decision task, variations in responding may have been reduced as a result of participants becoming habituated to the task. Specific feedback on accuracy and speed of response may produce a far greater differentiation between related and non-related words due to increased participant attending and motivation.

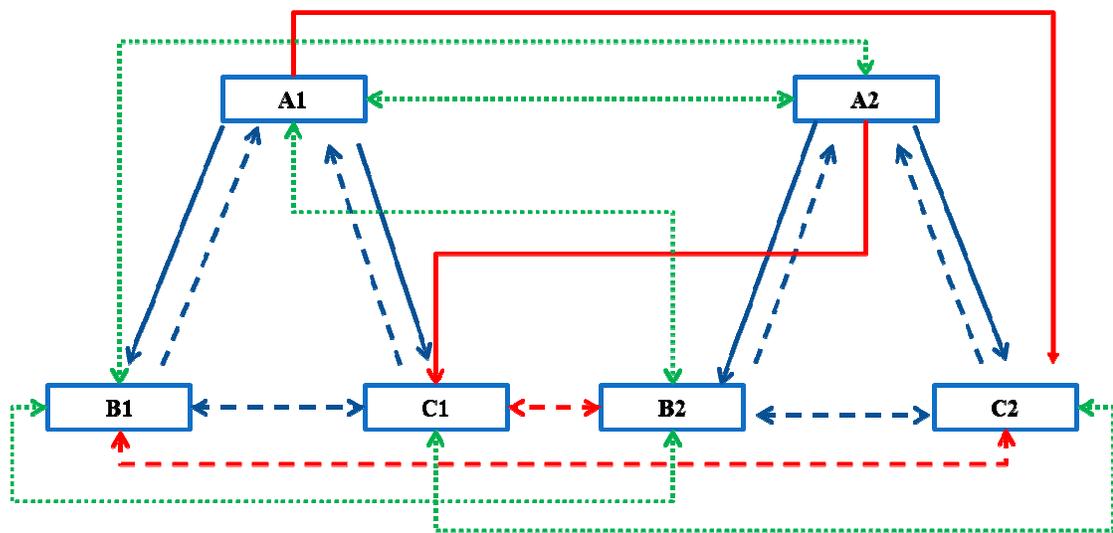


Figure 5. Possible Relations Between All Stimuli: In the above figure, solid lines represent directly trained relations while dashed lines represent derived relations expected from the contextually controlled networks. While not contextually appropriate, relations between A1/A2, A1/B2, A2/B1, B1/B2, and C1/C2, as designated by the dotted lines, are possible through derived, multi-nodal combinatorial responding.

Unlike other derived relational studies evaluating priming effects, this study employed contextually controlled classes in which stimuli were shared across classes. Whelan et al., (2005) also employed such inter-related classes, however, did not incorporate contextual cues within the lexical decision task. As such, it is difficult to evaluate the efficacy of particular contextual cues, in this case colored backgrounds, within the derived relational responding/lexical decision task procedures. While no

formal report was required of participants, some participants reported that the flash of the background color was distracting and inhibited their ability to recognize the target word. This self-report is supported by the finding that responses latencies to CS1 (blue background) were generally slower than for CS2 (red background) and CS^{absent} (grey background). Colored backgrounds were chosen for this study as they were unlikely to have been previously associated with particular word-like stimuli, they were formally different from the word-like stimuli, and because colored backgrounds had been successfully used in previous equivalence research as contextual stimuli (Dougher, Perkins, Greenway, Koons, & Chiasson, 2002). Evaluation of the perceptual or formal qualities of potential contextual stimuli with regards to the lexical decision task should be considered in further replications of these procedures.

As an analog to prejudicial responding, the results of this study did not sufficiently support the conceptualization that implicit contextual cues influence the transformation of prejudicial stimulus functions. As this study evaluated priming, one form of implicit responding, caution should be exercised when generalizing these findings to implicit responding in general. Other measures of implicit responding, such as those utilized by the IAT and IRAP procedures, may be more conducive to a study of context and prejudice as they require participants to respond to specific stimulus functions rather than simply identifying if a stimuli has a stimulus function.

Furthermore, it is important to note that the analog nature of this study limits generalization of its findings to the phenomenon of prejudice in the natural environment. The formation of prejudice in the natural environment undoubtedly involves numerous response functions that produce change in the environment that are beneficial, or

seemingly beneficial, to the individual. For example, a response that produces avoidance or escape from a non-preferred conceptualized group may decrease the immediate presence of aversive stimulus functions associated with that group. The current study did not associate any such stimulus function with the experimental stimuli. The experimental stimuli were neutral with respect to valence; the only functions attributed to them being their relation to other stimuli, and therefore may not have produced as varied responding as prejudicial stimuli may have. Future research in this area should evaluate the importance of preference and valence with regards to stimulus functions in producing model stimuli for contextually-controlled prejudicial responding.

Refinement of the experimental procedures and the reduction of the aforementioned limitations related to the particular stimuli utilized should improve future results and lend evidence to the role of implicit contextual-cues in the transformation of stimulus functions. Continued research on the role of implicit contextual control in derived relations may still prove valuable in the development of techniques, derived from Relational Frame Theory, as potential tools in the re-training prejudicial social behavior.

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Appendices

Appendix 1: Participant Information Sheet

Thank you for participating in our study. Please provide us with the following information.

Age: _____ yrs.

Gender: Male or Female

Is English your first language? Yes or No

Do you speak any other language? Yes or No

If yes, please specify: _____

For Office Use only:

- Parking pass Yes or No
- Informed Consent
- Participation Form
- Phase 1 Start-time: _____
- Break
- Phase 2 End-Time: _____
- Compensation form
- Debrief

Additional Notes:

Appendix 2: Word-Like Stimuli

From Whelan, Cullinan, O'Donovan, and Rodriguez Valverde (2005)

BETRET	BOCEEM	CASORS	DRAGER	HAVEEN	HEITER
LEWOLY	LORALD	MATSER	MURBEN	REMOND	RETTES
RIGUND	RONKEB	SAMOLT	SIFLET	SINALD	SURTEL
TROPER	VARTLE	WOLLEF	WRONED	CACHEN	DESUND

GEDEER

Appendix 3: Instructions for Phase 1 (MTS)

Thank you for participating in our study. During this phase of the experiment you will be presented with real foreign words. In a moment some words will appear on the screen. Your task is to match the word at the top of the screen with one of the three words at the bottom of the screen. To select a word at the bottom of the screen, begin by placing the mouse cursor over the word and then clicking the mouse button twice. Once selected, you will receive feedback according to your choice. Your goal is to get as many correct selections as possible. Your compensation is dependent upon your completion of this phase.

If you have any questions please ask the experimenter now.

Appendix 4: Instructions for LDT Phases

Instructions for Phase 2a Training (LDT)

During this phase of the experiment you will be asked to respond to some words. Some of these words will be real English words, and some will be non-words. Two words will appear, one after the other. Your task is to decide if the second word presented is a real English word, or a non-word. Please indicate your choice by pressing the “Z” key for a real word or by pressing the “M” key for a non-word. You will only have 2 seconds, after which a green X will appear. After each selection you will be asked to click the space bar to start the next trial. **YOU SHOULD WORK AS FAST AS YOU CAN WITHOUT MAKING MISTAKES.**

Instructions for Phase 2b Experimental (LDT)

Now that you have had some practice using English words, let’s begin with foreign words and non-words. During this phase you will be presented with pairs of words. Some words will be real foreign words that you have previous learned, and some will be non-words. Two words will appear one after the other. Your task is to determine whether the second word is a real foreign word or not. Please indicate your choice by pressing the “Z” key for a real word or by pressing the “M” key for a non-word. You will only have 2 seconds, after which a green X will appear. After each selection you will be asked to click the space bar to start the next trial. **YOU SHOULD WORK AS FAST AS YOU CAN WITHOUT MAKING MISTAKES.** Compensation during this phase will be dependent upon your performance.