ABSTRACT

Title of Document: **THE ROLE OF THE NEED FOR COGNITIVE CLOSURE IN IMPLICIT AND EXPLICIT RULE LEARNING**

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Two studies investigated the role of the need for cognitive closure in implicit and explicit rule learning. I generally hypothesized the existence of a relationship between the need for closure (NFC) and the learning of rules moderated by the type of learning, implicit versus explicit, occurring (Hypothesis 1). More specifically, I predicted that high (vs. low) NFC would predict better performance on an explicit rule learning task (Hypothesis 2) but worse performance on an implicit rule learning task (Hypothesis 3). I tested these hypotheses both by measuring the NFC as a stable, dispositional trait variable (Study 1) and manipulating it as a transient state variable (Study 2). The findings of Study 1 provide support for Hypotheses 1 and 2 but not Hypothesis 3. The findings of Study 2 provide support for Hypothesis 3 but not Hypotheses 1 and 2.

THE ROLE OF THE NEED FOR COGNITIVE CLOSURE IN IMPLICIT AND EXPLICIT RULE LEARNING

By

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Chapter 1: Background and Theoretical Rationale

Consider the following four scenarios. Upon catching a glimpse of his mom in the next room, a young child decides against sneaking a cookie from the pantry. A college student with a fifteen-minute lunch break opts for the shorter of two serving lines in her school's dining hall. A doctor diagnoses his patient with appendicitis. A rumored bankruptcy compels an investor to sell off all of her stock in the troubled company.

On the face of it, the decisions made by the players in each of these scenarios have very little in common; a child's resisting of cookie jar temptation seems worlds away a medical diagnosis. But though these decisions differ considerably in both their content and consequences, the *transformational*, *rule-governed* process that underlies them is one and the same.

When forming judgments, we use inference rules of a propositional logic nature to draw conclusions based upon the evidence at hand (Kruglanski & Gigerenzer, Under Review). Such rules follow an "If E then C" structure, where "E" is the evidence (cues) and "C" is the resulting conclusion (judgment). If we revisit my opening example adopting this propositional framework, we can easily identify the ruleful nature of each decision.

The boy likely decided not to take the cookie because he believed that *if* he did, *then* his mom would be upset, while the co-ed's choice of cafeteria line probably rested on the assumption that *if* the line is shorter, *then* the wait, too, will be shorter. The doctor's diagnosis was (hopefully) informed by medical training dictating that *if* a patient presents with a given cluster of symptoms, *then* the proper diagnosis is appendicitis. And the investor's decision to unload her stock presumably was driven by a belief that *if* the company filed for bankruptcy, *then* its stock value would depreciate considerably.

That rules are crucial to everyday decision-making is evidenced by a number of phenomena. Take, for one, the use of heuristics – simple (and, thus, cognitively efficient) decision rules we use to render judgments in the face the incomplete information. When utilizing the availability heuristic (Tversky & Kahneman, 1973), for example, individuals base their judgment regarding the likelihood of an event occurring on the ease with which they can bring an example of the event to mind. That is, they subscribe to the belief that *if* an example of an event is more easily recalled, *then* the event must occur more frequently.

The act of stereotyping can also be conceptualized as a rule-governed process, as a stereotype is simply a belief that "*if* person X belongs to social category Y, *then* person X must possess trait Z". Thus, when a stereotype is employed, the social category Y serves as a cue, or evidence, of Person X's possession of trait Z, which the person doing the stereotyping uses to render his or her stereotypic judgment. Finally, propositional logic has even been implicated in perception (e.g., Kleffner & Ramachandran, 1992; Pizlo, 2001; Rock, 1983), insofar as the brain makes unconscious inferences based on the visual stimuli to which it is exposed.

So, how is it that we come to acquire these rules that so pervade human decision-making? It has been demonstrated that rules can be learned both *explicitly* and *implicitly* (e.g., Reber, 1976). Whereas explicit learning is hypothesis-driven learning that takes place through the conscious, active involvement of the individual and produces knowledge that the individual is cognizant of, implicit learning occurs through the passive involvement of the individual, takes place entirely outside of his or her awareness, and produces knowledge that the individual can apply, but cannot directly access (Dienes & Perner, 2002). According to Cleeremans (2002), learning must satisfy three criteria in order to be considered implicit: (1) there is neither the intention to learn, (2) nor awareness of learning on the part of the individual, and (3) he or she finds it difficult to express (e.g., verbally articulate) the knowledge that is being drawn upon.

Although interest in learning without awareness dates back to the 1930s (e.g., Jenkins, 1933; Thorndike & Rock, 1934), the study of implicit learning is generally recognized to have truly begun with Reber's seminal artificial grammar learning (AGL) studies of the 1960s and 1970s (Matthews & Roussel, 1997; French & Cleeremans, 2002). Artificial grammars are highly simplified analogs of natural language wherein constructed rule systems govern the combination of a set of letters or other symbolic elements (Allen & Reber, 1999). In the first part of Reber's (1967, Study 2) AGL study, participants memorized letter strings derived from a set of such artificial grammar rules. Upon completion of this task, participants were informed of the fact that those letter strings had been generated from a specific set of rules, and were then asked to categorize a set of novel letter strings as either adhering to those same rules, or not.

Some of the letter strings participants were asked to classify in the testing phase of the study were, in fact, ruleful; others were not. Reber demonstrated that participants were able to correctly categorize the testing phase letter strings at an above chance rate yet were unable to verbalize the knowledge they used to do so. From this, he concluded that participants had "implicitly" learned the grammar rules.

The existence of an implicit process through which rules can be learned makes a great deal of intuitive sense, as a need to explicitly learn every rule used to render judgments would undoubtedly prove extremely cognitively taxing and, consequently, severely impede one's decision-making capabilities. Unlike explicit learning, implicit learning is not affected by anxiety (Rathus, Reber, Manza, & Kushner, 1994) or time pressure (Turner & Fischler, 1993), and is uncorrelated with IQ (Reber, Walkenfeld, & Hernstadt, 1991). And populations with explicit learning deficits, such as Alzheimer's (Reber, Martinez, & Weintraub, 2003) and Parkinson's patients (Witt, Nuhsman, & Deuschf, 2002), anterograde amnesiacs (Nissen & Bullemer, 1987), and young adults with mental retardation (Atwell, Conners & Merrill, 2003), have been shown to have relatively intact implicit learning capabilities compared to the normal population. Thus, the ability to implicitly learn rules appears to be highly functional and adaptive.

Given the importance of rules to human functioning, it is important to explore factors that may influence the explicit and implicit processes through which they are acquired. The present research examined one such factor – epistemic motivation or, more specifically, the need for cognitive closure.

The need for cognitive closure, henceforth referred to simply as the need for closure (NFC), describes a preference for a quick, definitive answer to a question (i.e., "closure") over prolonged uncertainty or ambiguity (Kruglanski, 1989). Individuals high in the NFC tend to quickly "seize" upon information that enables them to reach closure and "freeze" on the rendered judgment such that the closure is retained (Kruglanski, 1996). Given this concern with the acquisition of *evidence* for the quick formation of a *judgment*, the NFC seems to hold natural implications for the learning of rules.

The need for closure can be either manipulated (i.e., situationally induced) as a transient state variable or measured as a stable individual differences variable (for the scale, see Webster & Kruglanski, 1994). Examples of situational manipulations that have proven successful in eliciting a heightened need for closure include time constraints (Kruglanski & Freund, 1983), ambient noise (Kruglanski, Webster, & Klem, 1993), mental fatigue (Webster, Richter, & Kruglanski, 1996) and relative task dullness (Webster, 1993a). Webster and Kruglanski's (1994) 42-item scale measures the NFC as a single factor construct with five domains: (a) a desire for order and structure in one's environment, (b) a discomfort with ambiguity, (c) a preference for decisiveness, (d) a desire for predictability about the future, and (e) closed-mindedness.

Given this conceptualization of the NFC, we would expect rules to be particularly appealing to individuals high in the NFC insofar as they provide structure, order, and predictability – all things an individual with a heightened need for closure seeks. NFC's positive relationship to, at the individual level, Right Wing Authoritarianism (Roets & Van Hiel, 2006) and, at the group level, the emergence of autocratic leadership styles (Pierro, Mannetti, De Grada, Livi, & Kruglanski, 2003) appears to support this. Moreover, because high NFC individuals prefer to truncate their information search (Webster, Richter, & Kruglanski, 1996) and generate and test fewer hypotheses (Mayseless & Kruglanski, 1987), the NFC should engender a preference for well-defined decision rules, which would enable them to do this with greater ease.

There is evidence to suggest that individuals high in the NFC may not only have a stronger preference for rules, but may also over-rely on them. For one, individuals high in the NFC stereotype more than their low NFC counterparts (Kruglanski & Freund, 1983; Dijksterhuis, Van Knippenberg, Kruglanski, & Schaper, 1996). A general tendency to over-rely on rules might also underlie the finding that the NFC is accompanied by a heightened striving for consensus in group settings, as demonstrated by elevated tendencies for individuals high (vs. low) in the NFC to reject opinion deviates (Kruglanski & Webster, 1991) and bring up unique information during group discussion, presumably for the purpose of reaching consensus more quickly (Webster, 1993b). These findings could be construed as an overreliance on the consensus heuristic, or the belief that "consensus implies correctness" (see Axsom, Yates, & Chaiken, 1987), among high NFC individuals.

Although, based on the evidence presented above, I believe that individuals high in the NFC are inherently predisposed to prefer rules more than their low NFC counterparts, I do not expect this preference to always facilitate rule learning. Rather, I predict that NFC's role in the learning of rules will change according to whether the learning that is taking place is explicit or implicit. My specific hypotheses and their rationales are presented below.

The Present Research

Departing from the theoretical and empirical frameworks just discussed, I broadly hypothesized the existence of a relationship between the need for cognitive closure (NFC) and rule learning that is moderated by the type of learning (implicit versus explicit) taking place (Hypothesis 1). More specifically, I predicted that when they were aware that a rule existed, high NFC individuals would be more motivated than their low NFC counterparts to seek out and "seize" upon the structuring and ordering (and, thus, closure-providing) rule, resulting in better performance on an explicit rule learning task (Hypothesis 2). Conversely, I believed that a tendency for high NFC individuals to narrow their focus to the task at hand to the neglect of other aspects of their environment (i.e., succumb to "tunnel vision") would interfere with their ability to absorb cues in their environment containing useful information about rules that they were not aware existed and that this would, in turn, result in worse performance on an implicit rule learning task (Hypothesis 3). I now turn to a discussion of the two studies I carried out to test these hypotheses.

Chapter 3: Overview of Studies 1 and 2

Studies 1 and 2 both employed between-subjects designs, with the NFC and type of learning serving as the independent variables and performance in the testing phase of an AGL task serving as the dependent variable. Learning type was manipulated in both studies via instructional set (e.g., Reber, 1976), such that participants in the explicit conditions were informed that the letter strings they were going to be presented with in the learning phase would follow a set of rules, whereas participants in the implicit conditions were not provided with this information. Whereas, typically, in AGL studies contrasting implicit and explicit learning the instructional set not only informs participants in the explicit condition of the existence of rules but also strongly encourages participants to actively seek these rules out, I opted for a more minimal manipulation of explicit learning here. Because my hypothesis rests on the prediction that individuals high (vs. low) in the need for closure would be intrinsically more motivated to seek out rules, I wanted to observe the effect of the NFC on explicit learning in the absence of the introduction of an external motivation. Thus, the manipulation employed here consisted of simply informing participants in the explicit conditions of the existence of rules governing the letter strings they were about to be shown.

Learning of the rules from which the letter strings were generated was assessed in a subsequent testing phase, during which participants were asked to classify novel letter strings as either ruleful or non-ruleful. The proportion of correct responses was calculated and served as the dependent variable of interest. In Study 1, the NFC was measured as an individual differences variable; in Study 2, it was manipulated as a transient state variable. A full description of both studies' procedures and findings follows.

Chapter 4: Study 1 – The Need for Closure as a Trait Variable

Method

Participants

A total of 72 University of Maryland undergraduate students enrolled in a lower level psychology course participated in the study in exchange for extra course credit. Of these, five were omitted from the final analysis: four for scoring too highly on the five-item lie scale contained within the Webster and Kruglanski (1994) NFC scale and one because she informed the experimenter that she was dyslexic. This resulted in a final *N* of 67 participants.

Participants ranged in age from 18 to 22, with a mean age of 19.03 (*SD* = 1.00). Forty-one (61.2%) were female, while 26 (38.8%) were male. As there were no significant main or interactive effects of gender or age on the independent variable of interest, neither will be discussed further.

Materials

Twenty-seven letter strings ranging in length from three to seven characters were generated from Reber's (1967) grammar schematic, shown in Figure 1. Although some studies that have utilized this particular grammar schematic have included letter strings as long as eight letters, pilot testing revealed that participants struggled considerably with the learning phase task when letter strings of this length were included, therefore I decided to limit the length of strings to seven letters. Of these twenty-seven letter strings, twenty were used in the learning phase and the remaining seven were reserved for use in the testing phase. Learning phase strings were paired together such that (a) longer strings were paired with shorter strings and (b) one string in each set began with each of the two possible starting letters (T or V). The ordering of these pairings was randomly determined and fixed across participants (see Appendix A).

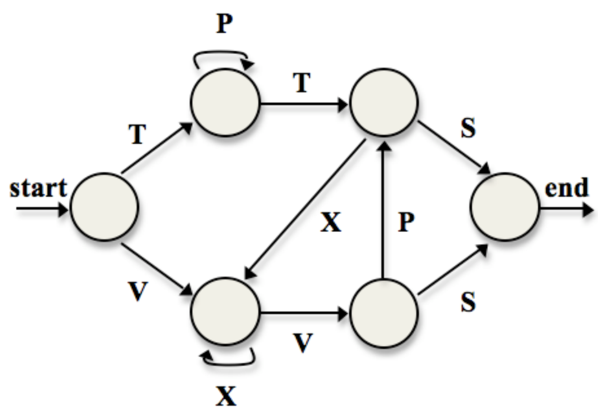

Figure 1. Grammar schematic used to generate ruleful letter strings (from Reber, 1967).

For the testing phase, thirteen non-ruleful letter strings were combined with the seven remaining ruleful letter strings for a total set of 20 letter strings (see Appendix B). Like the ruleful letter strings, the non-ruleful letter strings also ranged in length from three to seven characters and were fashioned from the letters, V, P, X, S, and T. The ordering of these 20 letter strings was randomly determined and fixed across participants. All letter strings were individually printed on 4”x6” index cards in 72-point serif font.

Procedure

Participants were randomly assigned to either the explicit or implicit learning condition (32 and 35 participants, respectively) and completed the experiment one at a time. Prior to beginning the AGL task, each participant completed the NFC scale, followed by the Positive and Negative Affect Scale (Watson, Clark, & Tellegen, 1988). The PANAS was used as a mind-clearing filler activity.

The experimenter then read instructions to the participant for the learning phase of the AGL task. The learning type manipulation was embedded in these instructions, with the script for the explicit learning condition reading as follows:

> "I am now going to show you 20 cards, one at a time, for 20 seconds each. Each card has a string of letters on it. Each of these letter strings adheres to the same specific set of rules. After showing you two cards in a row, I'm going to ask you to wait 20 seconds and then repeat back to me, in the order they were shown, both letter strings. If you repeat any part of either string incorrectly, or reverse their order, I will show you the two cards again, in the same way as before, and you will be asked to try again. Once you have correctly remembered that pair of cards, we will move on to the next pair."

The instructions for the implicit learning condition differed slightly from the above instructions in that the line, "Each of these letter strings adheres to the same specific set of rules", was omitted. Thus, whereas in the explicit condition participants were made aware of the fact the letter strings they were going to be shown were governed by a specific set of rules, participants in the implicit condition were not provided with this information.

All participants, after listening to their condition-specific instructions, completed the same two-phase task. During the first phase, the learning phase, participants were shown a series of 20 cards, one at a time, for 20 seconds each. After being shown two cards in a row, participants waited 20 seconds and then repeated back to the experimenter the letter strings on each of the two immediately preceding cards. Participants had to accurately recall each pair of letter strings before they were allowed move on to the next pair. The number of attempts it took participants to correctly recall each pair was recorded by the experimenter.

After working through all 10 pairs (20 cards, total) in this manner, participants in the implicit condition were informed that each of the letter strings they had just been asked to memorize followed a specific set of rules. They were not told what these rules were but were asked to provide their best guess as to what these rules might be. This question served as a manipulation check to ensure that for participants in the implicit learning condition, any knowledge gleaned from exposure to the rule-governed stimuli remained at an inarticulable (i.e., implicit) level. That is, the purpose of this question was to verify that participants in the implicit learning condition were not becoming consciously aware of the rules, which would violate one of the three definitional requirements of implicit learning previously discussed.

At this same juncture, participants in the explicit condition were reminded of the existence of rules governing the letter strings and were also asked to provide their best guess as to what these rules might be. In both conditions, participants' responses were recorded by the experimenter, which marked the end of the learning phase and beginning of the testing phase.

At the beginning of the testing phase, all participants were read the following instructions:

> "Okay, now I'm going to show you 20 more cards. For each card, please tell me whether you think the letter string on the card is ruleful or non-ruleful. If you think that it is ruleful, say "yes." If you think that it is not, say "no." You don't have to know the rules that the letter strings do or don't follow, just give me your best guess."

Participants were then presented with the 20 testing phase letter strings, one at a time, and asked to classify each letter string as ruleful or non-ruleful. Participants were given an unlimited amount of time to respond to each card. The proportion of strings correctly categorized was calculated for each participant and served as the dependent variable of interest.

Following the completion of the testing phase, participants answered a short demographic questionnaire, were debriefed by the experimenter, and were then dismissed.

Results

Manipulation Check

As previously discussed, the implicitness of any rule learning that took place was assessed at the conclusion of the learning phase by asking participants what they thought the rules governing the letter strings they had just been shown might be. Participant responses were coded (blind to condition) into one of five categories: (1) no guess (many participants simply stated "no idea" or "no guess"), (2) incorrect guess (e.g., "always followed rules of Roman numerals"), (3) correct guess but not a hard and fast decision rule (e.g., “a lot ended in VS and VPS”), (4) correct decision rule nonetheless unhelpful for distinguishing between non-ruleful and ruleful testing phase strings (e.g., “only five letters used, V, P, S, X, and T”), and (5) correct decision rule that could conceivably have improved the participant’s performance in the testing phase (e.g., “all ended in S”). Because many participants offered multiple guesses of varying quality, only the “best” guess for each participant was coded.

Twenty-one participants (31.3%) offered no guess at all. Twenty-seven participants (40.3%) provided guesses that were incorrect. Seven participants (10.4%) provided correct guesses that did not constitute decision rules. Six participants (9.0%) provided correct decision rules that were nonetheless unhelpful for the testing phase. And six participants (9.0%) provided correct decision rules that could have conceivably been helpful for distinguishing between ruleful and nonruleful strings presented in the testing phase.

Ultimately, for the purposes of the manipulation check, I was only interested in participants who fell into the latter category. Of the six participants that articulated such helpful, ruleful guesses, two had been assigned to the implicit condition. Consequently, these participants were removed from further analysis. Providing such a “helpful” guess was not required of participants in the explicit condition in order to prove explicit learning, as task instructions provided awareness of the rules, which satisfies the minimum definitional requirements of explicit learning previously discussed.

Learning Phase Performance

For each participant, the average number of attempts taken to correctly recall each pair of learning phase letter strings was calculated. The mean of average learning phase attempts across all participants was 1.58 (*SD* = .41) per pair. A regression revealed no significant main effects of either NFC (centered) or learning type (dummy coded) on average learning phase attempts, b = .003 (*SE* = .003), *t*(62) = 1.11, $p > .05$, $sr^2 = .019$ and b = -.130 (*SE* = .101), *t*(62) = -1.30, $p > .05$, $sr^2 =$ .026, respectively.

Regressing average learning phase attempts on NFC (centered), learning type (dummy coded) and the interaction between the two revealed a marginally significant NFC-learning type interaction, b = -.011 (*SE* = .006), *t*(61) = -1.99, $p = .051$, $sr^2 =$ .058. The calculation of the simple slopes for NFC within each learning type level revealed this to be driven by the positive and significant relationship between NFC and average learning phase attempts within the implicit learning condition, b = .009 (*SE* = .004), *t*(61) = 2.21, $p < .05$, $sr^2 = .120$; NFC did not significantly predict average learning phase attempts in the explicit learning condition, b = -.002 (*SE* = .004), *t*(61) = -.60, $p > .05$, $sr^2 = .014$. Average learning phase attempts did not predict testing phase performance, b = -.057 (*SE* = .041), *t*(63) = -1.38, $p > .05$, $sr^2 =$ .029.

Testing Phase Performance

The proportion of correctly categorized testing phase strings served as the dependent variable of interest. Regressing testing phase performance on NFC (centered) and learning type (dummy coded) revealed a significant main effect of learning type, b = .079 (*SE* = .032), $t(62) = 2.45$, $p < .05$, $sr^2 = .087$. There was no significant main effect of NFC, b = .001 (*SE* = .001), $t(62) = 1.00$, $p > .05$, $sr^2 = .015$.

I next investigated the existence of an interaction between NFC and learning type in predicting testing phase performance by regressing testing phase performance on NFC (centered), learning type (dummy coded) and the interaction between the two. The interaction was significant, b = .006 (*SE* = .002), $t(61) = 3.21$, $p < .01$, $sr^2 = .130$, providing support for Hypothesis 1.

I further probed this interaction by calculating the simple slopes of NFC within each condition (Figure 2, shown below).

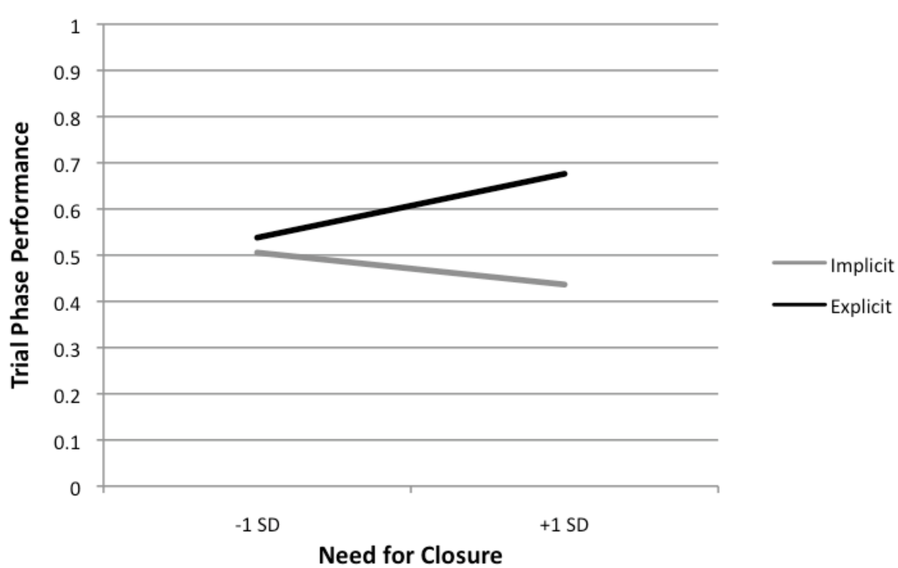

Figure 2. Simple slopes of NFC as a predictor of testing phase performance within learning type levels.

As expected, within the explicit learning condition, an increase in NFC predicted better testing phase performance, b = .004 (*SE* = .001), $t(61) = 3.03$, $p < .05$, $sr^2 = .278$. Therefore, Hypothesis 2 was also supported. Although the relationship was in the hypothesized negative direction, NFC did not significantly predict testing phase performance in the implicit condition, b = -.002 (*SE* = .001), $t(61) = 1.53$, $p > .05$, $sr^2 = .059$. Thus, Hypothesis 3 was not supported.

Discussion

The findings of Study 1 provide empirical support for two of my three hypotheses. There was a significant interaction between NFC and learning type in predicting testing phase performance, thus the relationship between the NFC and rule learning does appear to be moderated by the implicit versus explicit nature of the learning taking place. The simple effect of the NFC within the explicit learning condition was also significant and in the predicted direction, such that a higher NFC predicted better performance. However, the simple effect of the NFC within the implicit learning condition, though in the predicted negative direction, was not significant.

There was an interesting secondary finding worthy of mention – a marginally significant interaction between the NFC and learning type in predicting learning phase performance that was driven by a significant, positive relationship between the NFC and average learning phase attempts in the implicit learning condition. That is, it appears that in the implicit rule learning condition, individuals high in the NFC struggled more than their low NFC counterparts with recalling the letter strings they were asked to memorize.

Nonetheless, because learning phase performance was not predictive of testing phase performance, this finding (though intriguing and perhaps deserving of future research) was deemed to be inconsequential for the hypotheses being tested and was not investigated further here.

Chapter 5: Study 2 – The Need for Closure as a State Variable

Study 2 was a conceptual replication Study 1, differing only in its operationalization of the need for closure. Whereas in Study 1 the NFC was measured as a trait variable, in Study 2 it was manipulated as a state variable. This resulted in a 2 (Type of Learning: Implicit, Explicit) X 2 (NFC: High, Low) factorial design.

The NFC was manipulated at the beginning of the study's procedure, prior to the start of the AGL task, via a variation of the enjoyable subsequent task technique (e.g., Webster, 1993a), which involves informing participants that a (presumably) more enjoyable task follows the one they are presently engaged in. Participants were told either that they would be completing (a) a memory task followed by a personality test for which they would paint with watercolors (High NFC), or (b) two similar memory tasks (Low NFC). I opted for the enjoyable subsequent task manipulation over other more widely used NFC manipulations such as time pressure and cognitive load in order to avoid the potential alternative explanation that any effects found might be the result of the manipulation in and of itself interfering with the learning process (e.g., cognitive load impeding the ability to process the information at a deeper level), either in addition to or entirely apart from, the manipulation's impact on the NFC.

Methods

Participants

A total of 117 University of Maryland undergraduate students enrolled in a lower level psychology course participated in the study in exchange for extra course credit. Of these, three were omitted from the final analysis: one for suspicious responding, another because she informed the experimenter that she was dyslexic, and the final one for suspected cheating (typing the letter strings into a handheld mobile device) during the learning phase memory task. This resulted in a final *N* of 114.

Participants ranged in age from 16 to 40, with a mean age of 19.21 (*SD* = 2.45). Seventy-seven (67.5%) were female and 36 (31.6%) were male, with gender information missing for one participant. As there were no significant main or interactive effects of gender or age on the independent variable of interest, neither will be discussed further.

Materials

AGL task materials were identical to those used in Study 1. To increase the believability of the High NFC manipulation, water coloring kits and a cup containing water and paintbrushes were placed on a table next to participants assigned to the High NFC conditions.

Procedure

Participants were randomly distributed among the four experimental conditions (High NFC, Explicit Learning; Low NFC, Explicit Learning; High NFC, Implicit Learning; Low NFC, Implicit Learning) and completed the experimental procedure one at a time. Experimenters and participants were both blind to the study's hypotheses.

The NFC manipulation was administered at the beginning of the study procedure. Participants in the High NFC condition were told, “You’re going to be completing two tasks. The first task is a two-part memory and learning task. The second task is a personality task that will involve painting with watercolors. We’ll begin the first task now.” Participants in the Low NFC condition were told, “You’re going to be completing two tasks. Both are similar two-part memory and learning tasks. We’ll begin the first task now.” All participants then completed the same two-part AGL task and accompanying implicit/explicit manipulation check as in Study 1.

Because deception was employed to heighten NFC, participants also completed a suspicion check (“Is there anything about this study that strikes you as odd? If so, what?”) after the conclusion of the testing phase. They then completed a short demographic questionnaire and were debriefed and dismissed by the experimenter.

Results

Manipulation Check

Participant responses to the manipulation check were analyzed in the same way as in Study 1. Forty-seven participants (41.2%) offered no guess at all. Twenty-nine participants (25.4%) provided guesses that were incorrect. Twenty-seven participants (23.7%) provided correct guesses that did not constitute decision rules. Nine participants (7.9%) provided correct decision rules that were nonetheless unhelpful for the testing phase. And, most importantly for the purposes of the manipulation check, two participants (1.8%) provided correct decision rules that could have conceivably been helpful for distinguishing between ruleful and non-ruleful strings presented in the testing phase. One of these two participants was in an implicit learning condition, and thus was removed from further analyses.

Suspicion Check

The suspicion check was aimed at ensuring that the High NFC participants believed that they would be water coloring after the AGL task. No participant reported being suspicious of this cover story.

Learning Phase Performance

Average learning phase attempts across all participants was 1.53 (*SD* = .36). A two-way ANOVA revealed no significant main effects of either NFC or learning type on average learning phase attempts, $F(1,109) = .03$, $p > .05$, $\eta_p^2 = .000$ and $F(1,109) = .117$, $p > .05$, $\eta_p^2 = .001$, respectively, and no significant interaction between the two independent variables, $F(1,109) = .07$, $p > .05$, $\eta_p^2 = .001$. As in Study 1, average learning phase attempts was not a significant predictor of testing phase performance, b = -.003 (*SE* = .031), $t(111) = -.095$, $p > .05$, $sr^2 = .000$.

Testing Phase Performance

The general pattern of means for testing phase performance across all four conditions was as predicted (see Figure 3). A two-way ANOVA revealed a marginally significant interaction between NFC and learning type, $F(1,109) = 3.29$, $p = .07$, $\eta_p^2 = .029$. I tested Hypotheses 2 and 3 within the framework of a one-way ANOVA via planned comparisons between the High and Low NFC conditions within each learning type level. Hypothesis 2 was not supported, as the contrast between the

High NFC/Explicit (*M* = .55, *SD* = .10) and Low NFC/Explicit (*M* = .53, *SD* = .11) conditions was not significant, $t(109) = .552$, $p > .05$, $d = .150$. However, the contrast between the High NFC/Implicit (*M* = .45, *SD* = .11) and Low NFC/Implicit (*M* = .51, *SD* = .13) conditions was significant, $t(109) = 2.316$, $p < .05$, $d = .519$, providing support for Hypothesis 3.

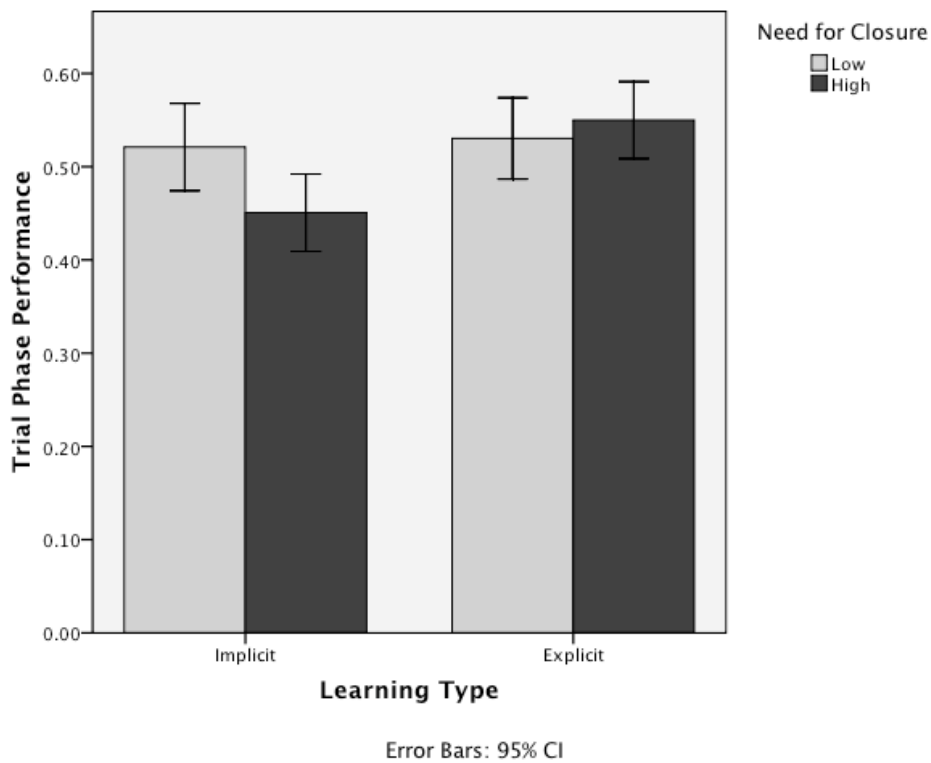

Figure 3. Testing phase performance means by condition.

<u>*Discussion*</u>

The results of Study 2 provide support for one of my three hypotheses. The contrast between High and Low NFC within the implicit learning level was significant and in the predicted direction, with Low NFC participants performing significantly better on the implicit learning task than their High NFC counterparts. Thus, Hypothesis 3 was supported. However, the contrast between High and Low NFC within the explicit learning level was not significant, and the overall interaction between NFC and learning type was only marginally significant, failing to provide support for Hypotheses 1 and 2.

Chapter 6: Average Effect Sizes Across Studies

To investigate the findings of both studies taken together, the Cohen's d's of the three hypothesized effects – (1) the interaction between the need for closure and learning type in predicting rule learning, (2) the need for closure's effect on explicit rule learning, and (3) the need for closure's effect on implicit rule learning – were averaged (weighted by sample size) across the two studies (see Table 1). The average interaction effect and average explicit effect were both small, $d = .241$ and $d = .274$, respectively. The average implicit effect was small-to-medium, $d = .390$.

Table 1. Summary of effect sizes and corresponding sample sizes across Studies 1 and 2.

	Study 1		Study 2		Weighted Average
	d	*N*	*d*	*N*	*d*
Interaction	.363	65	.166	113	.241
Explicit	.620	32	.150	58	.274
Implicit	.176	33	.519	55	.390

Chapter 7: General Discussion

The research presented here investigated the previously unexplored intersection of the need for cognitive closure and implicit and explicit rule learning. Drawing upon the theoretical frameworks and empirical findings of the two research domains in isolation from one another, I posited the existence of a relationship between the need for closure and rule learning that is moderated by the implicitness/explicitness of the learning transpiring.

Because a high NFC is associated with a desire for order and structure, predictability, and lack of ambiguity (Webster & Kruglanski, 1994), I hypothesized that individuals high (vs. low) in the NFC would perform better on an explicit rule learning task, presumably due to a heightened motivation to seek out the structuring, ordering, and thus closure-providing rules. Conversely, I hypothesized that a predisposition towards tunnel vision and, consequently, a failure to absorb/attend to informative cues in their environment would cause high (vs. low) NFC individuals to perform worse on an implicit rule learning task where they were not aware a rule existed. This prediction of NFC's opposite relationship to the two types of learning was congruent with existing evidence (e.g., Reber, Walkenfeld, & Hernstadt, 1991; Abrams & Reber, 1988; Witt, Nuhsman, & Deuschf, 2002; Nissen & Bullemer, 1987) of a dissociation of the implicit and explicit learning processes.

Taken as a whole, results from the two studies presented here appear to provide support for my three hypotheses. However, given the inconsistencies between the studies, these findings cannot be considered conclusive. My overall hypothesis that the relationship between the need for closure and rule learning is moderated by type of learning (implicit vs. explicit) was supported fully by the findings of Study 1, but only tenuously by the findings of Study 2 (via a marginally significant interaction). My more specific, directional hypotheses that high (vs. low) NFC would predict better performance on an explicit rule learning task but worse performance on an implicit rule learning task were each supported in one study (Studies 1 and 2, respectively), but neither was supported across both studies.

It is not clear what caused the discrepancies between the findings of my two studies. One possibility is that the NFC manipulation employed in the second study did not affect participants in the way I had intended. Future research might seek to test my hypotheses using an alternative manipulation of the need for closure. It is also possible that participants expected a roughly fifty-fifty split of ruleful/non-ruleful strings in the testing phase and that the nearly two-to-one ratio of non-ruleful to ruleful strings led to the biasing of participants' responses. Although I cannot think of a good reason for why systematic bias of this sort would have produced the pattern of inconsistent findings observed, it nonetheless might have introduced noise into the data that obscured some effects. Future research might also explore whether different effects are observed when participants in the explicit condition are not merely informed of the existence of the rules but strongly encouraged by the experimenter (i.e., externally motivated) to seek them out.

Ultimately, I believe that additional research into the role of the need for closure in implicit and explicit rule learning is warranted not only by the inconclusiveness of the findings presented here but also by the foundational nature of what is being investigated. Should the relationships proposed and investigated in the present research be more firmly established, it would provide considerable insight into rule learning, a process fundamental to human decision-making.

Appendices

Appendix A

Learning Phase Letter Strings

1a) VXXVPS

b) TPTXVS

2a) VXXVS

b) TPPPTS

3a) TPTXVPS

b) VVPS

4a) VVS

b) TTXXXVS

5a) TPPTS

b) VVPXXVS

6a) VXVPS

b) TPTXXVS

7a) TTXXVPS

b) VXVS

8a) TTS

b) VVPXVPS

9a) TPPPTS

b) VXXXVPS

10a) VXXXVS

Appendix B

Testing Phase Letter Strings

1) VSVS	11) VXS
2) TTXVS*	12) VVPTVPS
3) XXXTVS	13) VVPXXS
4) VXVPXVS*	14) VVPXVS*
5) TSTS	15) TTS
6) VXPVXS	16) PTSTPP
7) TPXTS	17) TPPTXVS*
8) TPPPPTS*	18) VVVPS
9) VXXXXVS*	19) TPTS*
10) TXVTPPS	20) TPPPTXV

*ruleful strings

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