Experiential Learning of Cultural Norms:

The Role of Implicit and Explicit Aptitudes

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Abstract

How should I greet her? Should I do what he requests? Newcomers to a culture learn its interpersonal norms at varying rates, largely through trial-and-error experience. Given that the culturally correct response often depends on conditions that are subtle and complex, we propose that newcomers' rate of acculturation depends on not only their explicit aptitude (e.g., reasoning ability) but also their implicit aptitude (e.g., pattern recognition ability). In Studies 1-3, participants experienced a range of influence situations sourced from a foreign culture. Across many trials, they decided whether or not to comply and then received accuracy feedback (based on what a majority of locals indicated to be the appropriate action in each situation). Across the three studies, stronger implicit aptitude was associated with greater improvement from trial-and-error experience, whereas stronger explicit aptitude was not. In Studies 4-6, participants experienced a range of greeting situations from a foreign culture. Across many trials, implicit aptitude predicted experiential learning, especially under conditions that impede reasoning: multiple cues, subliminal feedback, or inconsistent feedback. Study 7 found that the predictiveness of implicit aptitude was weaker under a condition that impedes associative processing: delayed feedback. These findings highlight the important role of implicit aptitude in helping people learn interpersonal norms from trial-and-error experience, particularly because in real-life intercultural interactions, the relevant cues are often complex, and the feedback is often fleeting and inconsistent but immediate.

Keywords: culture; norms; learning; implicit; explicit

Experiential Learning of Cultural Norms:

The Role of Implicit and Explicit Cognitive Abilities

As a newcomer to Japan, you would easily notice there are several types of bows, a common cultural greeting (e.g., *eshaku* [会釈], a 15-degree angle, and *saikeirei* [最敬礼], a 45-degree angle), but the challenge would be learning to recognize when each is called for. Anthropologists conclude that *eshaku* is generally used when polite gratitude is due or when greeting an acquaintance, whereas *saikeirei* is used when a strong apology is owed or to show respect for someone of high status (Amri, 2019). Recognizing these situations involves detecting several cues (e.g., offense or status) that may look different in Japan than in your own country. You can learn from locals, but they do not think in terms of the anthropologists' generalizations; they just know an *eshaku* situation (or a *saikeirei* situation*)* when they see one. A local may react in ways that convey whether you bowed correctly (or not), but their response may be too subtle and fleeting for you to notice, or it may come leavened with false praise that distorts the feedback. Or it may come much delayed. Given these challenges—complex cues and erratic feedback—it should not be surprising that many expatriates are slow to learn interpersonal norms.

In this age of record migration, more people than ever before face the challenge of learning a "new" culture, i.e., acculturation. Classic research on this learning challenge focused on ways to prospectively train expatriates, such as "cultural assimilator" exercises that teach students to make culturally appropriate explanations for behaviors that would be otherwise misunderstood (Morris et al., 2014b). Little research has focused on how expatriates learn from experience after arrival in a foreign country to become more behaviorally fluent. Interpersonal norms—the dance steps of social life in a culture—can be learned from feedback, but individuals differ greatly in how much they learn from repeated experiences of a type of interaction. It could be that this experiential learning, and variations therein, relies on people's explicit aptitude (e.g., reasoning) or their implicit aptitude (e.g., pattern recognition), or both.

The current studies take an individual difference approach to this question. We track how the rate of participants' experiential learning depends on a relevant explicit aptitude (i.e., reasoning ability) and an implicit aptitude (i.e., pattern recognition proclivity). The explicit aptitude predicts learning in domains such as military job performance (Ree et al., 1994). The implicit aptitude predicts learning of a second language (Pacton et al., 2001) and music (Rohrmeier & Rebuschat, 2012). Although people can learn contingencies of behavior through either predominantly explicit processes or predominantly implicit processes, the task conditions of learning cultural norms from interpersonal experiences provide reason to suspect a major role of implicit processes. Interpersonal responses, such as an *eshaku* bow, often hinge on multiple cues, which can be challenging for reasoning (Cleeremans, 1995). The feedback in other people's responses may be scarcely noticeable and may be distorted by their politeness, which poses further obstacles to explicit reasoning about the rules and the evidence. On the other hand, though, sometimes feedback is provided after a delay, a condition that interferes with implicit learning (Maddox et al., 2004). By experimentally varying these conditions, we test whether the role of implicit aptitudes in experiential learning of cultural norms varies depending on task conditions that interfere with either explicit reasoning or implicit learning mechanisms.

Acculturation

Psychology has traditionally conceptualized culture learning in terms of explicit reasoning and knowledge acquisition (Ward et al., 2001). Unlike anthropology, which relies on observation, cross-cultural psychologists rely primarily on self-report surveys that tap explicit knowledge (Berry et al., 1997). Psychologists assumed that newcomers to a culture think about its rules of behavior, and that their mistakes arise "either because they are unaware of the rules of social behaviour that regulate interpersonal conduct in their culture or, if aware of the rules, are unable or unwilling to abide by them" (Ward et al., 2001, p. 52). Scholars have assumed that expatriates deliberately induced rules and made a concentrated effort to follow them (Ward & Geeraert, 2016). In other words, cultural competence is acquired in the same way that expertise in chess is acquired—through deliberate reasoning and concentrated decision-making, which eventually becomes proceduralized and effortless.

As IQ is the key individual difference that underlies people's reasoning ability, this presumption of reasoning about rules implies that expatriates' IQ would greatly contribute to the rate at which they learn cultural norms from experience. Empirical studies find that expatriates' cultural adjustment (which is assumed to depend on the extent to which they learned local norms), however, is not associated with their IQ (e.g., Ward et al., 2009, Study 3; see Morris et al., 2019a; Morris et al., 2014b for reviews).

While not measured in past research, a different kind of cognitive aptitude might matter more. Learning the correct responses in interpersonal interactions requires registering complex patterns and picking up subtle and inconsistent feedback. Hence, an individual difference that may matter more is the proclivity for pattern recognition (Frensch & Rünger, 2003). People with a readiness to pick up patterns may be better equipped to learn the complexities of interpersonal responses from the limited feedback that experience offers.

In comparison to cross-cultural psychology (Triandis, 1989), cultural psychology introduced greater use of experiments and laboratory procedures that could capture people's implicit psychological tendencies (Adams & Markus, 2004; Kitayama, 2002; Nisbett et al., 2001). However, it has focused primarily on modeling differences in psychological processes between cultures, rather than on modeling how people learn new cultures, so the role of implicit processes in second-culture learning or acculturation has remained largely unstudied.

Implicit and explicit processes in learning

In cognitive psychology, researchers believe that learning occurs through a mix of explicit and implicit cognitive processes. In this tradition, explicit learning processes involve mechanisms for reasoning about general rules and evidence, whereas implicit learning processes are defined as “associative learning mechanisms that exploit statistical dependencies in the environment in order to generate highly specific knowledge representations” (Frensch & Rünger, 2003, p. 13; see also Cleeremans & McClelland, 1991). People can pick up statistical patterns in the environment through implicit processes even before they consciously recognize the patterns or contingencies involved (Perruchet & Pacton, 2006). Thus, implicit learning processes are associative in nature, whereas explicit learning processes are propositional or declarative in nature (Cleeremans & Dienes, 2008). Learners rely on explicit and implicit mechanisms to varying degrees depending on which type of learning the task lends itself to.

Reber (1967) developed a task that measures implicit learning. Without knowing that they will be tested on anything, participants read and type out ostensibly random letter strings—not told that there is a hidden structure to them (e.g., some letters appear only after other letters; see Reber et al., 1991, Figure 1). Then, in a surprise test, participants are presented with novel strings and asked whether the strings fit with the prior set or not; most participants can do so with above-chance accuracy even though they have not consciously induced the rule or “grammar” of the set (Reber, 1967). Process evidence suggests that people become tacitly familiar with statistical patterns in the set, and use this implicit knowledge to recognize new strings that belong to the set. Amnesiacs cannot form new explicit, declarative knowledge, but they perform as well as non-amnesiacs on Reber’s artificial grammar learning test (Knowlton et al., 1992; Knowlton & Squire, 1996).

Presently, Reber’s artificial grammar learning task is just one of many implicit learning tasks. Other commonly used tasks include the serial reaction time task (Nissen & Bullemer, 1987), which assesses the extent to which people have learned a repeated sequence of key presses, and the probabilistic classification task (Knowlton et al., 1994), which assesses the extent to which people have learned the probabilistic if-then relationships between a combination of multiple cues and a binary outcome. Our cultural norm learning task in Studies 4 to 6 is modeled after the probabilistic classification task. However, to measure implicit aptitude, we rely on Reber's artificial grammar learning task as that is the paradigmatic implicit learning task, and is procedurally distinct from our cultural norm learning tasks.

Reber et al. (1991) proposed that implicit learning occurs without awareness, but participants have some awareness of patterns in his artificial grammar task (Dienes et al., 1991) and in the serial reaction time task (Perruchet & Amorim, 1992). Others emphasize that the learning task must be incidental rather than prompted (Moors & De Houwer, 2006), but that is not true in the probabilistic classification task (Knowlton et al., 1994). Implicit processes need not be entirely nonconscious or incidental (Cleeremans & Dienes, 2008). The commonality between these tasks is that people acquire a competency from experience that exceeds or at least precedes their ability to consciously articulate what they know. This idea stands in contrast to the assumption in the culture learning literature that "conscious competence" precedes "unconscious competence" (Bhawuk, 1998; Bhawuk et al., 2008; Howell, 1982).

Individual differences in implicit and explicit aptitudes

Both explicit and implicit cognitive aptitudes can be studied as individual differences (Kaufman et al., 2010). Explicit aptitude can be reliably measured by IQ tests, such as Raven's Progressive Matrices (Raven et al., 1998), or other reasoning tests (see Johnson & Bouchard, 2005, p. 399), all of which feature problems that require deliberate mental effort. Implicit aptitude can be measured using participants' performance on tasks such as artificial grammar learning (Reber, 1967) or serial reaction time learning (Nissen & Bullemer, 1987), even though these were not initially designed as aptitude measures (Seger, 1994).

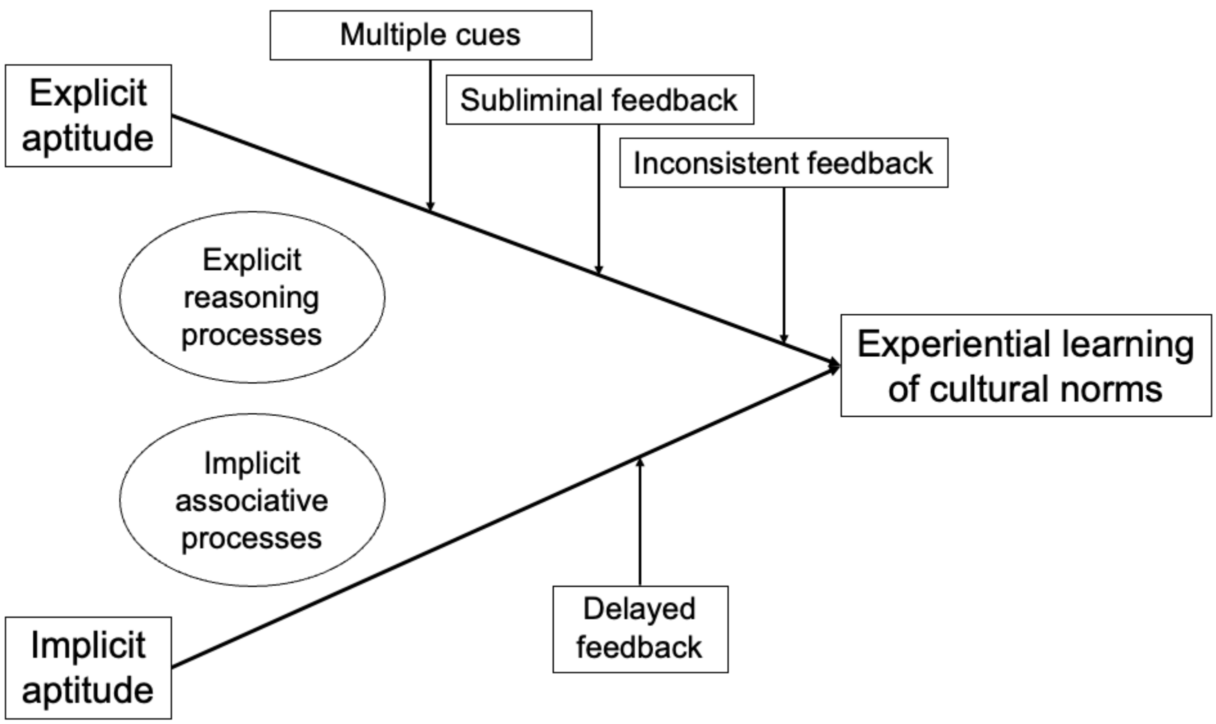
Cognitive psychologists traditionally assumed that individual differences in implicit aptitude are much smaller than in explicit aptitude (Reber et al., 1991; Stanovich, 2009). However, studies have found that individual differences in implicit aptitude are stable and reliable (Danner et al., 2011; Kalra et al., 2019; Kaufman et al., 2010), uncorrelated or weakly correlated with IQ, working memory capacity, and explicit associative learning (Kalra et al., 2019; Kaufman et al., 2010; Reber & Allen, 2000; Reber et al., 1991; Sobkow et al., 2018; Xie et al., 2013), and predictive of many aspects of linguistic proficiency and academic performance even after controlling for IQ and working memory (Kaufman et al., 2010; Siegelman & Frost, 2015). Even if there is less variation in implicit aptitude than in explicit aptitude, this makes for a conservative test of our proposal that implicit aptitudes should predict culture learning beyond explicit aptitudes.

Role of implicit and explicit aptitudes in culture learning under different conditions

In some domains, the culturally correct behavior depends categorically on a single cue. For instance, people in Japan remove their shoes when entering a home. This is also a domain where feedback about a mistake is unmissable (i.e., the alarmed host would always request the negligent guest to remove their shoes). Such a cultural pattern is easy to learn because it has the form of a simple rule and is articulated as such; people good at reasoning about rules would be particularly quick to pick up patterns of this type. By contrast, norms of interpersonal interactions usually depend on more than one cue, are harder to articulate, and are less clearly enforced (Goffman, 1967). Whether to call someone by their first name depends on many variables such as the relationship, relative status, setting, and audience; you know how to follow the norm, but it is too unwieldy to think about all these cues and their combinations in the form of a rule. The cue complexity impedes reasoning-based learning. People's ability to learn norms based on complex cues may depend less on their reasoning aptitude and more on their implicit proclivity for picking up patterns (Frensch & Rünger, 2003).

Other conditions also provide impediments. Even if one's behavior is incorrect, that might not be reinforced with clear feedback. For example, many hosts might react to an erring guest with a slight frown, refraining from explicitly requesting the guest to remove their shoes. The norm might be enforced inconsistently. If the host is in a hurry or distracted, they might not request the guest to remove their shoes. We argue that people with higher implicit aptitude, who are better able to pick up complex patterns in the environment, would exhibit greater improvement from trial-and-error experience when the norms to be learned are based on multiple cues or are enforced with fleeting or inconsistent feedback. Some evidence for this idea comes from research showing that people with higher implicit aptitude, as assessed through performance on the artificial grammar learning task, also perform better on the probabilistic classification task, which requires people to learn the association between multiple cues and an outcome through trial and error while receiving inconsistent feedback (Kalra et al., 2019, Table 2; cf. Brown et al., 2010). Studies 4-6 tested this hypothesis.

Figure 1. Illustration of the conceptual model. The arrows refer to task features that pose a challenge to the relevant learning process.



Under what conditions might people’s implicit aptitude fail to predict the rate at which they learn social interaction norms of a new culture through trial-and-error experience? One potential condition is delayed feedback (e.g., nobody says anything when a guest fails to remove their shoes before entering a home, but a colleague informs the guest the next day). Multiple studies have found that in category learning tasks in which the underlying rule is not verbalizable (and thus is difficult to deduce from reasoning), delaying the feedback by even five seconds can prevent people from learning the underlying rule (Maddox et al., 2004; Maddox &

Ing, 2005). By contrast, in category learning tasks in which the underlying rule is verbalizable, delaying feedback does not impair learning, as explicit reasoning is not dependent on immediate feedback—people can still use the information to deduce the appropriate behavior for a specific situation (Maddox et al., 2004). These findings lead us to predict that under conditions of delayed feedback, people with higher implicit aptitude would no longer exhibit greater improvement from trial-and-error experience. Study 7 tested this hypothesis. Figure 1 illustrates our conceptual model.

Overview of Studies

We conducted seven studies to test our hypotheses. In each study, we measured participants' implicit aptitude and explicit aptitude, and presented participants with a task in which they had to learn how to act in a culturally appropriate manner in interpersonal interactions in a foreign culture. In Studies 1-3 and 7, we presented participants with descriptions of actual interpersonal interactions in another culture and asked them to choose how they would act in each situation. The interactions differed on many different dimensions, so the conditions under which the different actions should be enacted could not be easily described. In Studies 4-6, we asked participants to learn how to greet others in a culturally appropriate manner in a foreign culture, and experimentally varied conditions under which implicit aptitude would be expected to predict vs. not predict the speed with which participants learned the greeting norms.

In each study, we report all participants, experimental conditions, and measures. Additional methods and results are provided in the Supplementary Materials. The materials, data, and code for all experiments are available at https://osf.io/udp7g/?view_only=b7a57865ecce4e678c0f4615671ced33. This research was approved by Nanyang Technological University's IRB under protocol IRB-2015-07-018-13, titled "Role of Implicit Processes in Cultural Learning," and by Columbia University's IRB under protocol IRB-AAAI0281, titled "Role of Implicit and Explicit Processes in Cultural Learning."

Sample size determination. The data were analyzed using a hierarchical logistic model (HLM; Raudenbush & Bryk, 2002), and the hypothesized effect is a cross-level interaction between a within-participant factor (trial) and between-participant factors (individual differences). HLM power analysis tools that existed when this project began did not provide a method for determining a participant sample size based on the effect size of cross-level interactions and desired power (Bosker et al., 2003; Raudenbush et al., 2011). Nevertheless, Table S4 in the Supplementary Materials reports post-hoc power analyses using packages that were developed more recently.

We sought to maximize statistical power by using precise multi-trial measures of both the independent variable and the dependent variable. Further, both the independent variable and the dependent variable were measured using performance tasks instead of self-reports. Specifically, the key independent variable, implicit aptitude, was measured using a task involving 100 test trials (see below for details). The dependent variable, culture learning, was measured using tasks involving 30 to 80 trials.

Measure of implicit aptitude. In all our studies, to measure implicit aptitude, we used the artificial grammar learning (AGL) task developed by Reber et al. (1991), as implemented by Brown et al. (2010). The task was divided into a learning phase and a test phase. In the learning phase, participants were presented with letter strings (e.g., PTTTVPS) and asked to memorize each string. After four seconds, the string disappeared, and participants were asked to type it out. If participants reproduced the string correctly, they saw “Good job!” displayed for one second and then proceeded to the next trial; if they responded incorrectly, they saw “Incorrect!” displayed for one second, followed by the same string repeated until they could reproduce it accurately (up to a maximum of 10 repetitions). Participants were presented with a total of 20 strings, each presented twice in two different blocks. In between the two blocks, participants were given an opportunity to take a short break. All the strings were derived from an artificial, semantic-free, finite-state grammar created by Reber and colleagues (1991). The strings had a minimum of three letters and a maximum of eight letters.

In the subsequent test phase, participants were informed for the first time that the strings that they had seen in the training phase were constructed using a complex set of rules. They were then presented with 50 novel strings, 25 of which followed the same set of rules as before (7 of the original strings plus 18 novel strings), and 25 of which did not follow the rules (created by introducing one or more violations into otherwise grammatical strings; see Reber et al., 1991). The 50 test strings were presented twice in two different blocks separated by a break. For each string, participants were asked to indicate whether or not the string was a “well-formed” string according to the rules, and had six seconds to make a response. If they did not respond within six seconds, the message “No response!” was presented for one second and the program proceeded to the next trial. Participants were not provided with any feedback in the test phase.

Although this task was not originally developed as an individual difference construct, the AGL measure has moderately high test-retest reliability and split-half reliability, leading Danner et al. (2011) to conclude: “Artificial grammar learning tasks can be used to measure individual differences in implicit learning. The low correlation with other ability constructs such as general intelligence suggests a good divergent validity of AGL. In line with previous research, the present results suggest that the reliability of the measurement is generally moderate and hence may be used for the study of individual differences” (p. 17).

Measures of explicit aptitude. To measure participants’ explicit aptitude, in Studies 2 to 6, we used the “series solution task” created by Reber et al. (1991), and in Study 7, we used Raven’s progressive matrices (Raven et al., 1998). The series solution task assessed whether participants could consciously identify the rule defining a string of letters and fill in a blank (e.g., the correct response for the string “ABCBDCCDE_” would be “D”). Participants received 20 such trials and had up to one minute to respond to each (see Reber et al., 1991 for details).

Therefore, both the implicit learning and the explicit learning tasks involved learning patterns embedded within strings of letters. These two tasks were specifically designed to be as comparable as possible (Reber et al., 1991). Whereas performance on the AGL task is minimally correlated with IQ, performance on the explicit aptitude task is highly correlated with IQ (Reber & Allen, 2000; Reber et al., 1991).

Before we describe the studies, it is important to ascertain whether these measures of implicit aptitude (IMP) and explicit aptitude (EXP) are indeed distinct. Table 1 presents the mean and standard deviation of IMP and EXP across all our studies, along with a meta-analysis across all studies, and reveals two key points. First, consistent with the traditional presumption that explicit abilities vary across individuals more than implicit abilities (e.g., Reber et al., 1991), the standard deviation in IMP, while substantial, was only 57% of the standard deviation in EXP. However, given that lower variance in a variable reduces the chances of finding a significant correlation (Sackett & Yang, 2000), the lower standard deviation of IMP compared to EXP stacks the odds against IMP and in favor of EXP, contrary to our hypotheses. Thus, the relatively lower variance of IMP makes the current studies a conservative test of our hypotheses.

Second, consistent with past research (Danner et al., 2011; Sobkow et al., 2018; Xie et al., 2013), the meta-analytic correlation coefficient between IMP and EXP across our studies was $r = .17$, $SE = .05$, $z = 3.54$, $p < .001$, 95% CI = [0.07, 0.26]. Thus, although there is a significant correlation between IMP and EXP, it is sufficiently small to conclude that IMP and EXP are distinct constructs.[1]

Table 1
Correlation between measures of implicit aptitude (IMP) and explicit aptitude (EXP) across studies.

[1] Note that we did not include additional measures of implicit learning and explicit learning in our studies. Thus, it is possible that the correlations across different measures of implicit learning and among different measures of explicit learning may not be much higher than that between the measures of implicit learning and explicit learning assessed in the current study. Therefore, the current findings should be interpreted with caution.

Study	Culture	*n*	IMP		EXP		$r_{IMP\text{-}EXP}$	*p*
			M	*SD*	*M*	*SD*		
1	India	40	0.54	0.08	.	.	N/A	N/A
2	USA	40	0.61	0.06	0.65	0.14	.31	.052
3	Singapore	40	0.59	0.06	0.64	0.15	.14	.39
4	USA	151	0.57	0.07	0.55	0.12	.15	.061
5	USA	71	0.61	0.07	0.65	0.13	.15	.20
6	USA	111	0.59	0.08	0.62	0.12	.12	.20
7	India	60	0.58	0.08	0.74	0.13	.22	.089
Meta-analysis			0.58	0.07	0.62	0.13	.17	< .001

Note: Both IMP and EXP are measured on a 0-1 scale. Means and SDs were meta-analyzed using a weighted average. The correlation was meta-analyzed using the procedure described by Goh et al. (2016). We used the random-effects approach of meta-analysis, which is more conservative and appropriate when the goal is to generalize beyond the available studies without assuming that there is only one true, “fixed” effect size (Goh et al., 2016).

Studies 1 to 3

Acculturation researchers have devised numerous interventions to help people have more positive interactions in a new culture, the most prominent of which is the *critical incidents* method (Flanagan, 1954; see Butterfield et al., 2005, for a review). The training scenarios typically describe a host national’s somewhat surprising behavior, followed by a multiple-choice question asking the trainee to select her best explanation for the host national’s behavior. Of the explanations provided, most rely on cultural stereotypes or misplaced assumptions, whereas one option is typically the correct, culturally appropriate explanation. Trainees are asked to select the explanation that they think is the best and are provided feedback. This “culture assimilator” (Fiedler et al., 1971) helps people avoid attributional misunderstandings, just as guidebook lists of *dos and don’ts* can help people avoid common faux pas. Importantly, this method trains people to make culturally appropriate rather than stereotypical explanations of foreigners’ behaviors; it does not specifically train people to act in a culturally appropriate manner in interpersonal interactions in a new cultural setting.

In the current research, we use a version of this method to get people to learn how to act in a culturally appropriate manner in social interactions in a new culture. In each study, we asked participants to learn the social interaction norms of an unfamiliar culture based on cultural snapshots (Weisbuch et al., 2017) – specifically, descriptions of everyday interpersonal interactions that had actually occurred in the unfamiliar culture. The set of interpersonal interactions used in the experiment were highly heterogeneous and varied on a large number of dimensions. In a prior study, natives of the culture had indicated the culturally appropriate behavior in each situation (Savani et al., 2011, Study 4). In the current study, we asked participants to learn to make decisions like natives, and provided them with feedback about whether or not their decisions matched those deemed appropriate by natives. Given the complexity of the social interactions sampled in these studies, the conditions in which a certain action is to be enacted could not be easily described. The learning task was adapted from Morris et al. (2019b, Study 1).

Study 1 Method

Participants. Following a previous study with similar methods and the same stimuli as those used in the current culture learning task (Savani et al., 2011, Studies 4 and 5), we decided on a target sample size of 40. We recruited 40 undergraduates (12 women, 28 men; mean age 20.60 years; all ethnic Indian) at a selective university in Bangalore, India.

Culture learning task. Our Indian participants went through 50 trials in which they were presented with brief descriptions of interpersonal influence interactions that had been previously described by US college students (Savani et al., 2011, Study 2). The stimulus descriptions were standardized, and all local references were changed to be more culturally general (e.g., *Christmas* was changed to *a religious holiday*). Each interaction described the relationship between the influencer and the influencee, the decision options that the influencee faced, the influencee's initial inclination versus the influencer's requested action, and the influencer's motive. For example: "Suppose you are with a friend and you are deciding between taking a nap or going to a lecture. You originally preferred to take a nap, but your friend is influencing you to go to lecture so that the two of you could sit together."

In a previous study, a group of American participants had rated whether, in each of these influence situations, accommodation to the influencer would have positive or negative consequences for the influencee (Savani et al., 2011, Study 4). If American participants' mean rating was above (below) the scale midpoint, we defined resisting the influencer (accommodating to the influencer) to be the culturally appropriate response. American participants indicated that resisting (accommodating to) the influencer was the culturally appropriate decision in 52% (48%) of these 50 interpersonal interactions sampled from the US. Thus, Indian participants were provided feedback based on what Americans said was the culturally appropriate decision in the US-sourced situations.

Each Indian participant was presented with these 50 US-sourced influence situations in a different random order. Participants were explicitly informed that the situations were sourced from the US. Participants were further instructed: "Once you make a response, you will receive +100 points if a majority of American students agreed with your response, and you will receive -100 points if a majority of American students disagreed with your response."

The situation descriptions stayed on the screen for a minimum duration depending upon the paragraph length (400 milliseconds per word). Thereafter, participants had to make a binary decision about whether to accommodate ("to do what the other person wants you to do") or to resist ("to NOT do what the other person wants you to do"). Participants were then provided feedback based on whether their decision matched the culturally appropriate decision as determined by US participants (see preceding paragraph). Specifically, participants saw either "CORRECT + 100 points" or "WRONG -100 points" displayed on the screen (in green and red color font, respectively) for two seconds. To increase participants' engagement with the task, we told them that the participant with the most points would receive a bonus of Indian Rupees 500 (approximately US$10 at the time of the study).

After the norm learning task, participants completed the AGL task. A measure of explicit aptitude was also administered, but it was corrupted due to a technical error (see Supplementary Materials).

Study 2 Method

Participants. Following the same logic as in Study 1, we decided on a target sample size of 40. We recruited 40 undergraduates (25 women, 15 men; mean age 19.80 years; 20 European American, 13 African American, 4 Latin American, 3 multiracial) at a selective university in New York City.

Norm learning task. The procedure was identical to that used in Study 1 except that the American participants in the current study were presented with 30 influence situations previously described by Indian college students (Savani et al., 2011, Study 2). In a previous study, a group of Indian participants had rated whether in each of these influence situations, accommodation to the influencer would have positive or negative consequences for the influencee (Savani et al., 2011, Study 4). If Indian participants' mean rating was above (below) the scale midpoint, we defined resisting the influencer (accommodating to the influencer) to be the culturally appropriate response. Indian participants indicated that resisting (accommodating to) the influencer was the culturally appropriate decision in 13% (87%) of these 30 interpersonal interactions sampled from India. Thus, American participants were provided feedback based on what Indians said was the culturally appropriate decision in the India-sourced situations.

After the norm learning task, participants completed the AGL task and the series solution task, which assessed explicit aptitude, in counterbalanced order.

Study 3 Method

Participants. Following the same logic as in Study 1, we decided on a target sample size of 40 Singaporean Chinese participants to obtain a culturally homogenous group. We recruited 40 Singaporean Chinese undergraduates (27 women, 13 men; mean age 20.45 years) at a selective university in Singapore. An additional three non-Chinese participants, who signed up for the study despite the eligibility criterion, were excluded from the analyses.

Norm learning task. The procedure was nearly identical to that used in Study 1—the Singaporean participants in this study had to learn the social interaction norms of 50 American influence situations. The only difference from Study 1 was that we split the long paragraph describing each situation into multiple sections, each with a heading. The six headings were: *place, other person, decision, your inclination, other person's request,* and *reason*. To increase participants' engagement with the task, we told them that the participant with the highest accuracy would receive a bonus of S$50 (approximately US$40 at the time of the study).

After the norm learning task, participants completed the AGL task and the series solution task in counterbalanced order.

Evidence for ecological validity

In an unrelated study (Madan et al., 2018), 91 Singaporean undergraduates completed the culture learning task used in Study 3 and then went abroad for a semester for a student exchange program for an average of 5.49 months. Upon their return, the authors measured their self-reported social interaction adjustment in the foreign country using four items, which were adapted from Black and Stephens (1989). Specifically, participants were asked: "Please tell us how unadjusted or adjusted you were with respect to the following aspects of living in the country you went to for your exchange: (1) Socializing with local people; (2) Interacting with local people on a day-to-day basis; (3) Interacting with local people outside of work or study; and (4) Speaking with local people; α=.94). The authors found that participants' speed of learning on the culture learning task, which they completed before they went abroad, significantly predicted their actual culture learning, as measured by their rating on a measure of social adjustment. These results held even after controlling for individual differences in personality (assessed using the Big 5; Gosling et al., 2003), explicit aptitude (assessed using Raven's Progressive Matrices), emotional intelligence (assessed using the STEM task;

MacCann & Roberts, 2008), and cultural intelligence (Ang et al., 2007). This finding provides evidence for the ecological validity of the culture learning task used in the current studies.

Results

Data analysis procedure. Following past research on learning (Bogaerts et al., 2017; Morris et al., 2019b), in each study, we modeled the slope of participants' learning curves in the culture learning task using a hierarchical logistic population-average model with robust standard errors (Raudenbush & Bryk, 2002). We used a hierarchical logistic regression because the trial-level dependent variable, participant's accuracy on each trial, is binary in nature (correct = 1, incorrect = 0). The predictor variables were trial (coded such that the first trial = 0 and the last trial = 1[2]), participants' aptitude scores (IMP and EXP; mean-centered), and interactions between trial and IMP / EXP. Given the coding, the effect of trial represents participants' change in accuracy from the first trial to the last trial, that is, their learning rate over the entire length of the learning task. Given past findings that Indians have a default bias toward accommodation (see Savani et al., 2011, Study 5), we expected our Indian participants to be overall more accurate when *accommodation* is the culturally appropriate response in a US influence situation than when *resistance* is the culturally appropriate response. Therefore, we included the correct response option (i.e., either *accommodate* or *resist*; dummy coded) as a trial-level covariate.

The model first conducts a logistic regression within each individual to estimate the change in the individual's accuracy across successive trials (i.e., estimating each participant's learning slope); it then takes the estimated parameters from all individuals to conduct a between-individual regression (i.e., assessing how participants' learning slope varies as a function of their implicit and explicit abilities); it then adjusts the within-individual logistic parameters based on the between-individual parameters, and so on, until the model converges

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[2] We used the formula trial_recoded = (trial_original - 1) / 49, which converted the original trial numbers ranging from 1 (first trial) to 50 (last trial) to new trial numbers ranging from 0 (first trial) to 1 (last trial).

(see Raudenbush & Bryk, 2002, Chapter 3; for details). Table 2 presents the descriptive statistics, and Table 3 presents the results of the HLM models.

Table 2

Descriptive statistics for Studies 1 to 3.

Variable	*M*	*95% CI*	Range	*SD*	*t*(39)
		Study 1			
IMP	54%	52% - 57%	44% - 74%	8%	3.59***
Norm learning	55%	51% - 59%	34% - 85%	12%	2.55*
		Study 2			
IMP	61%	59% - 63%	47% - 72%	6%	11.95***
EXP	65%	60% - 69%	25% - 90%	14%	6.45***
Norm learning	77%	74% - 79%	50% - 100%	9%	18.86***
		Study 3			
IMP	59%	57% - 61%	48% - 76%	6%	8.81***
EXP	64%	59% - 68%	30% - 90%	15%	5.97***
Norm learning	56%	54% - 59%	38% - 68%	8%	5.09***

Note. The *t*-test column reports the results of one-sample *t*-tests assessing whether the mean of the variable is significantly different from 50%. *IMP, EXP, and Norm learning* refer to performance on the implicit aptitude task, explicit aptitude task, and norm learning task, respectively. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 3

Summary of the results of Studies 1 to 3.

	Study 1	**Study 2**	**Study 3**
Constant	*B*=.17, 95% *CI* [.03, .31], *SE*=.07, *z*=2.39, [*N* = 40]	*B*=1.22, 95% *CI* [1.05, 1.38], *SE*=.08, *z*=14.48, [*N* = 40]	*B*=.05, 95% *CI* [-.06, .16], *SE*=.06, *z*=.94, [*N* = 40]
Main effect Trial	**N.S.** *B*=.092, 95% *CI* [-.24, .43], *SE*=.17, *z*=.54, *p*=.59	**SIG.** *B*=.66, 95% *CI* [.27, 1.06], *SE*=.20, *z*=3.32, *p*=.001	**N.S.** *B*=.13, 95% *CI* [-.15, .40], *SE*=.14, *z*=.92, *p*=.36
Main Effect IMP	**N.S.** *B*=1.48, 95% *CI* [-.35, 3.30], *SE*=.92, *z*=1.59, *p*=.11	**N.S.** *B*=1.16, 95% *CI* [-1.16, 3.48], *SE*=1.18, *z*=.98, *p*=.33	**N.S.** *B*=.87, 95% *CI* [-.83, 2.57], *SE*=.87, *z*=1.00, *p*=.32
Main Effect EXP	N/A	**N.S.** *B*=.25, 95% *CI* [-.54, 1.04], *SE*=.40, *z*=.63, *p*=.53	**N.S.** *B*=-.15, 95% *CI* [-.84, .55], *SE*=.35, *z*=.42, *p*=.67

IMP x Trial	**SIG.** *B*=4.84, 95% *CI* [.35, 9.33], *SE*=2.29, *z*=2.11, *p*=.034 **MORE IMPROVEMENT OVER TRIALS**	**SIG.** *B*=9.98, 95% *CI* [4.32, 15.64], *SE*=2.89, *z*=3.46, *p*=.001 **MORE IMPROVEMENT OVER TRIALS**	**SIG.** *B*=3.26, 95% *CI* [.41, 6.12], *SE*=1.46, *z*=2.24, *p*=.025 **MORE IMPROVEMENT OVER TRIALS**
EXP x Trial	N/A	**SIG.** *B*=-3.00, 95% *CI* [-5.67, -.32], *SE*=1.37, *z*=2.19, *p*=.028 **WORSENING PEROFRMANCE OVER TRIALS**	**N.S.** *B*=-.11, 95% *CI* [-2.25, 2.03], *SE*=1.09, *z*=.10, *p*=.92

Note. *B* represents the unstandardized coefficient from the hierarchical logistic model. *SE* represents the standard error of this coefficient. *Z* represents the standard normal statistic, equal to *B* / *SE* (computed on the original values with 6 decimal places).

Preliminary results. Participants' average performance on the norm learning task was much higher in Study 2, in which US participants were learning from Indian situations, than in Studies 1 and 3, in which Indian and Singaporean participants were learning from US situations. This is because accommodating to vs. resisting the influencer was culturally appropriate in 87% vs. 13% of the Indian situations, in which case participants can perform quite well if they decide to always accommodate no matter what. However, accommodating to vs. resisting the influencer was culturally appropriate in 48% vs. 52% of the US situations, in which case participants had to learn to discriminate between the two types of situations—adopting a uniform decision rule would not help in this case. Table S1 in the Supplementary Materials presents participants' average accuracy in the norm learning task first third, middle last, and last third of the trials, and Table S2 presents the correlations between participants' IMP and EXP and their performance in these three sets of trials.

Primary results. In each study, participants with higher implicit aptitude (IMP) exhibited greater improvement in performance on the norm learning task from experiential feedback, as indicated by a significant and *positive* IMP x Trial interaction. This result held across participants from different cultures (the US, India, and Singapore), and across stimulus sets of situations sampled from two different cultures (the US and India). Participants with higher explicit aptitude (EXP) did not exhibit any improvement.

Simple slopes analyses. In Study 1, at one standard deviation below the mean on implicit aptitude, the simple effect of trial was nonsignificant, *B* = -.27, 95% *CI* [-.70, .17], *SE* = .22, *z* = 1.21, *p* = .23. However, at one standard deviation above the mean on implicit aptitude, there was a marginal positive effect of trial, *B* = .45, 95% *CI* [-.058, .96], *SE* = .26, *z* = 1.74, *p* = .082, indicating that participants who were high on implicit aptitude became more accurate across successive trials.

In Study 2, at one standard deviation below the mean on implicit aptitude, the simple effect of trial was nonsignificant, *B* = .087, 95% *CI* [-.43, .60], *SE* = .26, *z* = .33, *p* = .74. However, at one standard deviation above the mean on implicit aptitude, there was a significant positive effect of trial, *B* = 1.24, 95% *CI* [.74, 1.74], *SE* = .26, *z* = 4.82, *p* < .001, indicating that participants who were high on implicit aptitude became more accurate across successive trials. At one standard deviation below the mean on explicit aptitude, there was a significant positive effect of trial, *B* = 1.09, 95% *CI* [.61, 1.57], *SE* = .24, *z* = 4.48, *p* < .001, indicating that participants who were low on explicit aptitude became more accurate across successive trials. However, at one standard deviation above the mean on explicit aptitude, the simple effect of trial was nonsignificant, *B* = .24, 95% *CI* [-.37, .85], *SE* = .31, *z* = .76, *p* = .45.

In Study 3, at one standard deviation below the mean on implicit aptitude, the simple effect of trial was nonsignificant, *B* = -.081, 95% *CI* [-.41, .25], *SE* = .17, *z* = .48, *p* = .63. However, at one standard deviation above the mean on implicit aptitude, there was a significant positive effect of trial, *B* = .34, 95% *CI* [.011, .66], *SE* = .17, *z* = 2.03, *p* = .043, indicating that participants who were high on implicit aptitude became more accurate across successive trials.

Figures 2-4b illustrate the simple slopes across the three studies. The simple slope lines tend to appear straight when participants' average accuracy is close to 50%, as the sigmoid function (which is used in logistic regressions) is approximately linear, around 50%. The simple slope lines tend to appear concave when participants' average accuracy approaches either 0% or 100%, as the sigmoid function concave around the two extremes.

Discussion

Studies 1-3 consistently found that participants with higher implicit aptitude improved more with experience when trying to learn to make the culturally appropriate decision in interpersonal interactions, through trial-and-error experience. In contrast, participants with higher explicit aptitude did not have a higher learning rate.

An examination of the figures indicates that in Studies 1 and 3, in which participants were trying to learn how to act in American influence interactions, participants with high vs. low IMP both started out with near-chance accuracy. However, the accuracy of high IMP participants improved with trial-and-error experience, whereas that of low IMP participants did not improve. In Study 2, in which participants were trying to learn how to act in Indian influence interactions, participants with either high or low IMP started out at above-chance accuracy, and the accuracy of both improved over successive trials. However, the accuracy gain was higher for high IMP participants.

In Study 2, high EXP participants had higher accuracy at the start than low EXP participants; however, low EXP participants had a higher learning rate, which led to this gap being closed by the end of the experimental session. Thus, one explanation for the negative effect of EXP is that high EXP participants started out higher because they were more likely to guess the culturally appropriate action in early trials, and thus had less room to rise. In Study 3, EXP was unrelated to participants' rate of learning.

Studies 4 to 7

The learning task in the three initial studies contained some ambiguities and challenges because the verbal descriptions of interpersonal situations that participants responded to varied on multiple dimensions. Furthermore, because the situations were derived from sampling people's everyday social interactions rather than through design, they did not vary systematically on a fixed number of dimensions. Thus, we cannot tell precisely which dimensions were diagnostic of the culturally appropriate decision, or which features of the task helped or hindered participants' ability to learn from the feedback.

To investigate specific conditions under which participants with higher implicit aptitude might exhibit greater improvement from trial-and-error experience, we designed social situations that varied systematically on a limited number of cues. Instead of long verbal descriptions, each interaction was represented by a picture of the local person along with a few words about the context. We created a fictitious social interaction norm in a foreign culture. Across 80 trials, each participant was asked to choose between two possible ways of greeting the local person. This method was adapted from Morris et al. (2019b, Study 2). We measured IMP and EXP in counterbalanced order using the same artificial grammar task and the series solution task used in the previous studies (Reber et al., 1991), except for Study 7, in which we used Raven's progressive matrices (Raven et al., 1998) to assess EXP. With this operationalization, we gain better experimental control and internal validity by using designed situations and norms.

In Studies 4-6, participants were provided feedback based on whether their responses were consistent with a pre-determined greeting norm set by the researcher. In Study 7, we used Study 1's method for providing participants' feedback on the accuracy of their responses.

Study 4

This study varied whether the cultural greeting norm that participants had to learn was based on a single cue or based on multiple cues. Past research on category learning has found that when exemplars are categorized based on a single cue, people typically learn to distinguish the categories using a logical reasoning process, which likely draws on their explicit aptitude; but when exemplars are categorized based on a combination of multiple cues, people learn by "integrating perceptual information from different stimulus components at a pre-decisional level" (Ashby & Maddox, 2011, p. 147), a process that likely draws on their implicit aptitude (Cleeremans & McClelland, 1991). Accordingly, we hypothesized that when the norm was relatively straightforward (i.e., in the single-cue condition), participants with higher implicit aptitude would not improve more from trial-and-error experience, but when the norm was complex (i.e., in the multi-cue condition), participants with higher implicit aptitude would exhibit greater improvement.

Participants. As this study was run online, we targeted a larger sample size of 200 participants. We sought to recruit 200 US residents from Amazon Mechanical Turk, and 202 US residents completed the study. Of these, nine responders were excluded because they came from duplicate IP addresses. An additional nine participants were excluded because they indicated encountering technical problems (Savani & King, 2015). Finally, 33 participants were excluded because they failed an attention check (Oppenheimer et al., 2009) in which they had to answer “none” to two questions (“How many times do you eat / drink per day?”). The final sample consisted of 151 participants (61 women, 90 men; mean age 35.57 years; 119 European American, 12 African American, 7 Latin American, 4 Asian American, 1 Native American, 8 multiracial).

Participants were randomly assigned to either the single-cue condition or the multi-cue condition of the norm learning task.

Norm learning task. Participants were asked to imagine that they had recently moved to Mongolia and would encounter 80 different Mongolians in this task. They were informed that people in Mongolia use one of two different greetings—a wave and a salute. Every time they encountered someone, participants had to choose whether to *wave* or *salute*. They were instructed that their task is to learn how to appropriately greet people in Mongolia, and that the participant with the best performance would receive a bonus of $10.

Participants were then presented with faces of 80 different individuals of East Asian ethnicity, half men and half women, taken from the Asian Emotion database (Wong & Cho, 2009). The faces were presented in a different random order for each participant. Below each face, we presented a sentence specifying (1) whether the person was indoors or outdoors, (2) whether it was daytime or nighttime, (3) whether the person was sitting or standing, and (4) whether the person was alone or with another person (e.g., "You encounter this individual when she is outside. It is nighttime. She is standing and alone"). Thus, each trial consisted of a face followed by four additional cues.

In the single-cue condition, the greeting norm was based on either the person's gender (salute men and wave to women), location (salute indoors and wave outdoors), or time of day (salute during daytime and wave during nighttime). Participants in the single-cue condition were randomly assigned to one of these three sub-conditions. In the multi-cue condition, the greeting norm was based on a combination of these three cues (i.e., wave to women inside in the day or outside in the night, and men outside in the day or inside in the night; wave to all others). The other two cues—sitting or standing, and alone or with other person—were used as foils.

Participants were asked to press *S* to *salute* and *W* to *wave* (there was no time limit for the response). If participants made a greeting consistent with the norm in their assigned condition, they saw "Good" displayed on the screen for two seconds. If they made a greeting inconsistent with the norm, they saw "Bad" displayed for two seconds.

Study 5

This study varied whether the feedback that participants received in the cultural norm learning task was supraliminal or subliminal. People can learn context-action associations even from subliminal cues (Pessiglione et al., 2008). By definition, subliminal cues are not accessible to the explicit learning system, so the implicit learning system must have helped people learn from subliminal cues. Consistent with this idea, regions involved in implicit learning (e.g., the ventral striatum) were implicated in learning from subliminal cues (Pessiglione et al., 2008). Our study goes beyond Pessiglione et al.'s study by asking whether individual differences in implicit aptitude predict the speed with which people learn from subliminal feedback. We hypothesized that when the feedback was easily discernible (i.e., in the supraliminal feedback condition), participants with higher implicit aptitude would not improve more from trial-and-error experience.

However, when the feedback was not easily discernible (i.e., in the subliminal feedback condition), participants with higher implicit aptitude would exhibit greater improvement.

Participants. A pilot study indicated large differences in participants' speed of learning with subliminal vs. supraliminal feedback: the learning curve was 7.49 times steeper (in log-odds units) in the supraliminal condition than in the subliminal condition. Given the large difference across these two conditions, we expected to achieve high power even with a small sample size, and thus targeted a sample size of 25 participants per cell in this study. In addition to running the two key conditions—supraliminal feedback and subliminal feedback—we added a third, no feedback condition to ensure that any learning effects in the subliminal feedback condition are because of the feedback that participants received and not because of a general drift in participants' response tendency across successive trials. We recruited 72 undergraduates (41 women, 26 men, 5 unreported; mean age 21.97 years; 33 European American, 13 African American, 7 Latin American, 2 other, 12 multiracial, 5 unreported) at a selective university in New York City. One participant did not complete the implicit aptitude task and thus was dropped from the analyses.

Norm learning task. Participants were asked to imagine that they had recently moved to a central Asian country called Tavanistan and had to learn how to appropriately greet people there. They were informed that people in this country use one of two different greetings: shaking hands and bowing. Every time they encountered someone, participants had to choose whether to *shake hands* or *bow*. To ensure that participants in the subliminal feedback condition and no feedback condition are not disturbed by the perceived lack of feedback, we instructed all participants, "In Tavanistan, people's smiles and frowns are very quick, so you might or might not see them. Even when an expression is too quick for your eye to see, your brain still registers and processes it. So just do your best to learn when to shake hands with people and when to bow to people in Tavanistan."

The stimuli for this task consisted of 8 sets of Asian faces, half women and half men (Beaupré et al., 2000). Each face came with three expressions: neutral, smiling, and frowning. We repeated each face 10 times for a total of 80 trials, which were presented in a different random order for each participant. The task was to learn the norm, "Shake hands with women, bow to men." Each trial began with a fixation cross displayed at the center of the screen for one second, followed by a face with a neutral expression. After another second, the text "Bow or Shake hands?" appeared below the face. Participants could respond by pressing *B* for bow and *S* for shake hands (there was no time limit for the response).

If participants' response was consistent (inconsistent) with the norm, in the supraliminal feedback condition, the facial expression changed from neutral to a smile (frown), and the new expression stayed on the screen for 427 milliseconds. In the subliminal feedback condition, the facial expression changed from neutral to a smile (frown) and the new expression stayed on the screen for 27 milliseconds, and was then masked with the original neutral expression for 400 milliseconds, which renders the change in facial expression subliminal (Bargh & Chartrand, 2000; Bargh et al., 1996, Experiment 3). We used a combination of forward and backward masking, that is, the smiling or frowning face (displayed for 27 milliseconds) was both preceded and followed by a face of the same person but with a neutral expression, which likely made the feedback difficult, if not impossible, to detect consciously (Esteves & Öhman, 1993). In the no feedback condition, the neutral face continued to be displayed on the screen for 427 milliseconds. The next trial then began with a fixation cross.

Study 6

This study varied whether, in the cultural norm learning task, participants received consistent feedback (i.e., the feedback reinforced the same norm across all trials) or inconsistent feedback (i.e., the feedback reinforced one norm in a majority of trials but the opposite norm in the remaining trials). In particular, even people with amnesia can learn the relevant contingencies in the probabilistic classification task, in which participants are provided with inconsistent feedback (Knowlton et al., 1994); as amnesiacs cannot carry forth their explicit reasoning from one trial to the next, learning in this task likely draws on individuals' implicit aptitude. But if people were provided with consistent feedback, they can readily induce the rule through reasoning and hypothesis testing, which likely draws on their explicit aptitude. We thus hypothesized that when the feedback was consistent across all trials, participants with higher implicit aptitude would not exhibit any improvement across successive trials. However, when the feedback was inconsistent across different trials, participants with higher implicit aptitude would exhibit greater improvement.

Participants. We targeted a somewhat larger sample size of 60 participants per cell in this study as we anticipated that we could recruit at most 120 participants in the lab before the end of the semester. A study seeking 120 participants was posted at a selective university in New York City, but only 111 students completed the study before the end of the semester (82 women, 29 men; mean age 22.24 years; 59 European American, 22 African American, 16 Latin American, 4 Middle-eastern American, 2 East Asian American, 3 other, 1 multiracial, 4 unreported). Participants were randomly assigned to either the consistent feedback condition or the inconsistent feedback condition of the norm learning task.

Norm learning task. The task was very similar to that used in Study 4 with a few changes: (1) participants were informed that they were visiting the fictional country Tavanistan; (2) the greetings were changed to *bow* or to *shake hands*, and (3) participants were only presented with faces without any text underneath. The greeting norm was to *bow to women and shake hands with men*. In the *consistent feedback condition*, participants received consistent feedback on all trials (i.e., responses following / violating the norm always received "Correct" / "Wrong" feedback, respectively). In the *inconsistent feedback condition*, responses following / violating the norm received "Correct" / "Wrong" feedback in only 75% of the trials. In the remaining 25% of the trials, we provided participants with false feedback (i.e., responses following / violating the norm always received "Wrong" / "Correct" feedback, respectively).

Study 7

This study varied whether participants received immediate feedback or delayed feedback in the cultural norm learning task. We hypothesized that in the immediate feedback condition, participants with higher implicit aptitude would exhibit greater improvement from trial-and-error experience, but in the delayed feedback condition, this would no longer be the case.

Participants. The experimental manipulation used in this study was directly derived from Maddox et al. (2004), who used 25-29 participants per cell in each of their experiments. Thus, we decided to recruit 30 participants per cell. We recruited 60 undergraduates (13 women, 47 men; mean age 20.98 years; all ethnic India) at a selective university in Bangalore, India. Participants were randomly assigned to either the immediate feedback condition or the delayed feedback condition of the norm learning task.

Norm learning task. The norm learning task was nearly identical to that in Study 3. Participants were presented with 30 influence situations previously described by American college students. These 30 situations were a subset of the set of 50 situations used in Study 1. Each participant was presented with a random subset presented in random order.

In the *immediate feedback condition*, participants received the feedback ("Correct + 100 points" / "Wrong -100 points") immediately after their response, followed by a 5-second blank screen. In the *delayed feedback condition*, participants saw a 5-second blank screen after their response, followed by the feedback.

Studies 4 to 7: Results

We used the same procedure as in Studies 1 to 3 to analyze the data. The HLM method that we used to analyze the data has a "homogeneity of variance" assumption (see Raudenbush & Bryk, 2002, Chapter 9). However, this assumption did not hold in Studies 4-6, as the 95% confidence interval of the level-1 variance did not overlap across the two conditions in each study (see Supplementary Materials, Table S3). Therefore, in each study, we could not analyze the two conditions in a single omnibus model, and instead had to analyze each condition using a separate HLM model. Table 4 presents the descriptive statistics, and Table 5 presents the study results. Table S1 in the Supplementary Materials presents participants' average accuracy in the norm learning task first third, middle last, and last third of the trials, and Table S2 presents the correlations between participants' IMP and EXP and their performance in these three sets of trials.

Table 4

Descriptive statistics for Studies 4 to 7.

Variable	*M*	95% *CI*	Range	*SD*	*t*-test
			Study 4		
IMP	57%	56% - 58%	42% - 77%	7%	*t*(150) = 12.07***
EXP	55%	53% - 57%	25% - 90%	12%	*t*(150) = 5.49***
Norm learning single cue	76%	72% - 81%	40% - 100%	20%	*t*(79) = 11.75***
Norm learning multiple cues	50%	49% - 52%	36% - 81%	7%	*t*(70) = 0.40
			Study 5		
IMP	61%	59% - 63%	50% - 74%	7%	*t*(70) = 13.63***
EXP	65%	61% - 68%	35% - 95%	13%	*t*(70) = 9.37***
Norm learning no feedback	44%	38% - 49%	6% - 61%	12%	*t*(19) = -2.28*
Norm learning subliminal	68%	59% - 77%	23% - 98%	22%	*t*(25) = 4.28***
Norm learning supraliminal	93%	90% - 96%	69% - 100%	7%	*t*(24) = 29.23***
			Study 6		
IMP	59%	57% - 60%	37% - 78%	8%	*t*(111) = 11.58***
EXP	62%	60% - 65%	30% - 95%	12%	*t*(111) = 10.55***
Norm learning consistent	93%	90% - 96%	50% - 100%	11%	*t*(52) = 29.06***
Norm learning inconsistent	68%	64% - 72%	43% - 94%	14%	*t*(58) = 9.70***
			Study 7		
IMP	58%	56% - 60%	44% - 74%	8%	*t*(59) = 7.53***
EXP	74%	71% - 77%	42% - 100%	13%	*t*(59) = 14.10***
Norm learning immediate	57%	54% - 61%	40% - 80%	9%	*t*(29) = 4.34***
Norm learning delayed	53%	50% - 57%	33% - 70%	10%	*t*(29) = 1.98

Note. The *t*-test column reports the results of one-sample *t*-tests assessing whether the mean of the variable is significantly different from 50%. *IMP, EXP, and Norm learning* refer to performance on the implicit aptitude task, explicit aptitude task, and norm learning task, respectively. * *p* < .05, ** *p* < .01, *** *p* < .001.

Table 5
Summary of results from Studies 4-7.

Study	Independent variable	Conditions	
		Single cue	**Multiple cues**
4	Constant	*B*=1.27, 95% *CI* [.99, 1.55], *SE*=.14, *z*=8.96, [*N* = 80]	*B*=.01, 95% *CI* [-.05, 0.74], *SE*=.03, *z*=0.38, [*N* = 71]
4	Main effect Trial	**SIG.** *B*=1.25, 95% *CI* [.78, 1.71], *SE*=.24, *z*=5.21, *p*<.001	**SIG.** *B*=.31, 95% *CI* [.11, .51], *SE*=.10, *z*=3.03, *p*=.002
4	Main Effect IMP	**N.S.** *B*=1.21, 95% *CI* [-2.61, 5.03], *SE*=1.95, *z*=.62, *p*=.54	**N.S.** *B*=.14, 95% *CI* [-.54, .81], *SE*=.34, *z*=.40, *p*=.69
4	Main Effect EXP	**N.S.** *B*=.81, 95% *CI* [-1.44, 3.06], *SE*=1.15, *z*=.71, *p*=.48	**N.S.** *B*=.26, 95% *CI* [-.46, .99], *SE*=.37, *z*=.71, *p*=.48
4	IMP x Trial	**N.S.** *B*=-4.80, 95% *CI* [-11.62, 2.02], *SE*=3.48, *z*=1.38, *p*=.17	**SIG.** *B*=2.76, 95% *CI* [.84, 4.68], *SE*=.98, *z*=2.81, *p*=.005 **MORE IMPROVEMENT OVER TRIALS**
4	EXP x Trial	**N.S.** *B*=.93, 95% *CI* [-2.67, 4.52], *SE*=1.83, *z*=.51, *p*=.61	**SIG.** *B*=-2.06, 95% *CI* [-3.85, -.27], *SE*=.91, *z*=2.25, *p*=.024 **WORSENING PEROFRMANCE OVER TRIALS**
		Supraliminal feedback	**Subliminal feedback**
5	Constant	*B*=3.52, 95% *CI* [3.03, 4.00], *SE*=.25, *z*=14.23, [*N* = 25]	*B*=1.03, 95% *CI* [-.57, 1.50], *SE*=.24, *z*=4.34, [*N* = 26]
5	Main effect Trial	**SIG.** *B*=4.24, 95% *CI* [3.29, 5.20], *SE*=.49, *z*=8.69, *p*<.001	**SIG.** *B*=1.37, 95% *CI* [.99, 1.74], *SE*=.19, *z*=7.15, *p*<.001
5	Main Effect IMP	**N.S.** *B*=5.36, 95% *CI* [-1.95, 12.67], *SE*=3.73, *z*=1.44, *p*=.15	**N.S.** *B*=4.75, 95% *CI* [-2.41, 11.92], *SE*=3.66, *z*=1.30, *p*=.19
5	Main Effect EXP	**N.S.** *B*=2.18, 95% *CI* [-1.00, 5.37], *SE*=1.62, *z*=1.34, *p*=.18	**N.S.** *B*=1.03, 95% *CI* [-2.70, 4.76], *SE*=1.90, *z*=.54, *p*=.59.
5	IMP x Trial	**N.S.** *B*=8.67, 95% *CI* [-6.40, 23.73], *SE*=7.68, *z*=1.13, *p*=.26	**SIG.** *B*=8.61, 95% *CI* [2.47, 14.76], *SE*=3.13, *z*=2.75, *p*=.006

5	EXP x Trial	**N.S.** *B*=-.93, 95% *CI* [-6.75, 4.88], *SE*=2.97, *z*=.31, *p*=.75	**MORE IMPROVEMENT OVER TRIALS** **SIG.** *B*=-4.19, 95% *CI* [-7.07, -1.30], *SE*=1.47, *z*=2.85, *p*=.004 **WORSENING PEROFRMANCE OVER TRIALS**
[redacted]			
		Consistent feedback	**Inconsistent feedback**
6	Constant	*B*=3.05, 95% *CI* [2.28, 3.81], *SE*=.39, *z*=7.83, [*N* = 53]	*B*=.77, 95% *CI* [.60, .93], *SE*=.09, *z*=9.00, [*N* = 59]
6	Main effect Trial	**SIG.** *B*=2.46, 95% *CI* [.96, 3.96], *SE*=.77, *z*=3.21, *p*=.001	**N.S.** *B*=.19, 95% *CI* [-.020, .40], *SE*=.11, *z*=1.78, *p*=.075
6	Main Effect IMP	**N.S.** *B*=4.76, 95% *CI* [-7.23, 16.75], *SE*=6.12, *z*=.78, *p*=.44	**N.S.** *B*=1.72, 95% *CI* [-.093, 3.54], *SE*=.93, *z*=1.86, *p*=.063
6	Main Effect EXP	**SIG.** *B*=4.09, 95% *CI* [.38, 7.79], *SE*=1.89, *z*=2.16, *p*=.031	**N.S.** *B*=-.065, 95% *CI* [-1.31, 1.18], *SE*=.63, *z*=.10, *p*=.92
6	IMP x Trial	**N.S.** *B*=.63, 95% *CI* [-18.85, 20.11], *SE*=9.94, *z*=.06, *p*=.95	**SIG.** *B*=2.54, 95% *CI* [.66, 4.42], *SE*=.96, *z*=2.64, *p*=.008 **MORE IMPROVEMENT OVER TRIALS**
6	EXP x Trial	**SIG.** *B*=9.98, 95% *CI* [4.80, 15.17], *SE*=2.64 *z*=3.77, *p*<.001 **MORE IMPROVEMENT OVER TRIALS**	**N.S.** *B*=.52, 95% *CI* [-1.15, 2.19], *SE*=.85, *z*=.61, *p*=.54
[redacted]			
		Immediate feedback	**Delayed feedback**
7	Constant	*B*=-.021, 95% *CI* [-.42, .004], *SE*=.11, *z*=-1.92, [*N* = 30]	*B*=-.06, 95% *CI* [-.23, .11], *SE*=.08, *z*=-.70, [*N* = 30]
7	Main effect Trial	**N.S.** *B*=.29, 95% *CI* [-.20, .78], *SE*=.25, *z*=1.16, *p*=.24	**N.S.** *B*=.0056, 95% *CI* [-.40, .41], *SE*=.21, *z*=.03, *p*=.98
7	Main Effect IMP	**N.S.** *B*=.16, 95% *CI* [-1.66, 1.99], *SE*=.93, *z*=.18, *p*=.86	**SIG.** *B*=3.11, 95% *CI* [1.84, 4.38], *SE*=.65, *z*=4.81, *p*<.001
7	Main Effect EXP	**N.S.** *B*=.78, 95% *CI* [-.50, 2.07], *SE*=.65, *z*=1.19, *p*=.23	**SIG.** *B*=-.86, 95% *CI* [-1.58, -.14], *SE*=.37, *z*=2.35, *p*=.019

7	IMP x Trial	**SIG.** *B*=6.77, 95% *CI* [1.52, 12.01], *SE*=2.68, *z*=2.53, *p*=.011 **MORE IMPROVEMENT OVER TRIALS**	**N.S.** *B*=1.48, 95% *CI* [-3.23, 6.20], *SE*=2.41, *z*=.62, *p*=.54
7	EXP x Trial	**N.S.** *B*=1.80, 95% *CI* [-2.11, 5.72], *SE*=2.00, *z*=.90, *p*=.37	**N.S.** *B*=1.30, 95% *CI* [-2.21, 4.81], *SE*=1.79, *z*=.73, *p*=.47

Note. *B* represents the unstandardized coefficient from the hierarchical logistic model. *SE* represents the standard error of this coefficient. *Z* represents the standard normal statistic, equal to *B* / *SE* (computed on the original values with 6 decimal places).

Studies 4 to 6 found that participants' implicit ability, IMP, especially predicted the speed with which they learned new norms under task conditions that impede reflective learning—multiple cues, subtle feedback, or inconsistent feedback. Implicit ability did not predict participants' speed of learning new norms in relatively unchallenging contexts, that is, when they had to learn norms based on a single cue, supraliminal feedback, and consistent feedback. Conversely, Study 7 found that although participants' implicit ability predicted their speed of learning new cultural norms from immediate feedback, it failed to predict their speed of norm learning under a task condition that impedes implicit learning: delayed feedback.

Study 5 additional results. In Study 5, which varied whether participants received supraliminal or subliminal feedback, we ran an analogous regression in the no feedback condition, and found that there was no learning, *B* = -.032, 95% *CI* [-.39, .33], *SE* = .18, *odds ratio* = 1.033 *z* = .18, *p* = .86. Therefore, the learning effect in the subliminal priming condition can be attributed to the subliminal changes in expression rather than to a drift in participants' response tendencies across successive trials.

Overall, participants' accuracy was quite high in the supraliminal condition at 93%, possibly because the norm that participants had to learn was based on a single cue (i.e., the target person's gender), and we provided participants with consistent feedback. Repeating each of the eight faces ten times could also have played a role in increasing participants' accuracy. Thus, the learning rate, and the interactions between the learning rate and IMP / EXP, should be interpreted with caution in this condition.

Simple slopes analyses. The simple slopes for Studies 4 to 7 are presented in Figures 5a to 8d We discuss simple slopes associated with significant interactions here. In Study 4, in the multi-cue condition, with reference to implicit aptitude, the simple effect of trial was significant at one standard deviation above the mean, *B* = .50, 95% *CI* [.26, .73], *SE* = .12, *z* = 4.10, *p* < .001, but not significant at one standard deviation below the mean, *B* = .12, 95% *CI* [-.12, .36], *SE* = .12, *z* = .98, *p* = .33 (see Figure 5c). This result indicates that in the multi-cue condition, participants who were higher on implicit aptitude became more accurate across successive trials. With reference to explicit aptitude, the simple effect of trial was significant at one standard deviation below the mean, *B* = .55, 95% *CI* [.28, .82], *SE* = .14, *z* = 3.94, *p* < .001, but nonsignificant at one standard deviation above the mean, *B* = .064, 95% *CI* [-.24, .37], *SE* = .16, *z* = .41, *p* = .68 (see Figure 5d). This result indicates that in the multi-cue condition, participants who were lower on EXP became more accurate across successive trials.

In Study 5, in the subliminal feedback condition, with reference to implicit aptitude, the simple effect of trial was significant at one standard deviation below the mean, *B* = .78, 95% *CI* [.28, 1.28], *SE* = .26, *odds ratio* = 2.18, *z* = 3.04, *p* = .002; however, it was much stronger at one standard deviation above the mean, *B* = 1.95, 95% *CI* [1.34, 2.57], *SE* = .31, *odds ratio* = 7.06, *z* = 6.23, *p* < .001, as indicated by an odds ratio that was more than three times as large (see Figure 6c). With reference to explicit aptitude, the simple effect of trial was significant at one standard deviation below the mean, *B* = 1.91, 95% *CI* [1.38, 2.44], *SE* = .27, *z* = 7.02, *p* < .001, and at one standard deviation above the mean, *B* = 0.82, 95% *CI* [.30, 1.35], *SE* = .27, *z* = 3.08, *p* = .002 (see Figure 6d).

In Study 6, in the consistent feedback condition, with reference to explicit aptitude, the simple effect of trial was nonsignificant at one standard deviation below the mean, *B* = 1.23, 95% *CI* [-.28, 2.75], *SE* = .77, *z* = 1.59, *p* = .11, but significant at one standard deviation above the mean, *B* = 3.68, 95% *CI* [1.94, 5.42], *SE* = .89, *z* = 4.15, *p* < .001 (see Figure 7b). This indicates that when participants were provided with consistent feedback, participants who were higher on explicit aptitude became more accurate across successive trials. In the inconsistent feedback condition, with reference to implicit aptitude, the simple effect of trial was significant at one standard deviation above the mean on implicit aptitude, *B* = .40, 95% *CI* [.11, .69], *SE* = .15, *z* = 2.69, *p* = .007, but not significant at one standard deviation below the mean, *B* = -.015, 95% *CI* [-.24, .21], *SE* = .12, *z* = .13, *p* = .90 (see Figure 7c). This indicates that when participants were provided with inconsistent feedback, only participants who were high on implicit aptitude became more accurate across successive trials.

In Study 7, in the immediate feedback condition, the simple effect of trial was significant at one standard deviation above the mean on implicit aptitude, *B* = .84, 95% *CI* [.18, 1.50], *SE* = .34, *z* = 2.48, *p* = .013, but not significant at one standard deviation below the mean, *B* = -.25, 95% *CI* [-.89, .38], *SE* = .32, *z* = .78, *p* = .44. In the delayed feedback condition, the simple effect of trial was not significant at one standard deviation above, *B* = .12, 95% *CI* [-.31, .56], *SE* = .22, *z* = .57, *p* = .57, or below the mean on implicit aptitude, *B* = -.11, 95% *CI* [-.77, .54], *SE* = .34, *z* = .34, *p* = .74. This indicates that when participants were provided with delayed feedback, they failed to learn the social interactions norms of another culture irrespective of their IMP.

Discussion

The results of Studies 4-7 were consistent with our predictions. When the underlying greeting norm could be readily inferred (i.e., when it was based on a single cue, enforced with supraliminal feedback, or enforced with consistent feedback), participants with higher implicit aptitude did not exhibit greater improvement across successive trials. But when the norm could not be readily inferred (i.e., when it was based on multiple cues, enforced with subliminal feedback, or enforced with inconsistent feedback), participants with higher implicit aptitude improved more from trial-and-error experience. Importantly, we are not claiming that in these conditions, participants do not form any conscious representation of the greeting norm by the end of the experimental session; we are merely claiming that the underlying norm could not be as readily inferred in the multi-cue, subliminal feedback, and inconsistent feedback conditions as in the other conditions.

Study 7 used the method of Studies 1-3, in which participants were presented with verbal descriptions of interpersonal influence situations from another culture. The immediate feedback condition replicated the key finding of Study 1, that people with higher IMP improved more with trial-and-error experience. But when participants received delayed feedback, people with higher implicit aptitude did not exhibit any improvement across successive trials. This study thus identified a condition under which the robust association between implicit aptitude and speed of learning social interaction norms (identified in Studies 1-3 and replicated in the immediate feedback condition of Study 7) disappears, thus specifying a boundary condition of the benefits of implicit aptitude for culture learning.

General Discussion

Seven studies indicated that people with higher implicit aptitude improved more from trial-and-error experience when trying to learn the social interaction norms of a new culture. Specifically, Studies 1-3 asked participants to learn the culturally appropriate behavior in interpersonal influence situations that had occurred in another culture. The situations were heterogeneous and varied on many dimensions, and the underlying cultural norm could not be stated verbally. We found that Indian, American, and Singaporean participants with higher implicit aptitude improved more across successive trials in terms of learning when to accommodate vs. when to resist influence attempts of a foreign culture. We found conceptually parallel results in three cultures—the US, India, and Singapore—and across cultural norm stimuli derived from two cultures—the US and India. Thus, the current findings appear to be culturally generalizable.

Studies 4-7 identified the conditions under which people with higher implicit aptitude are particularly likely to improve over successive trials when trying to learn the greeting norms of a fictitious culture. When the greeting norm was based on multiple cues, when the feedback was subliminal, or when the feedback was inconsistent, participants with higher implicit aptitude exhibited greater improvement across successive trials. But when the greeting norm was based on a single cue, when the feedback was clearly discernible, or when the feedback was consistent, participants with higher implicit aptitude did not improve to a greater extent. Similarly, under a condition that especially impeded implicit learning—when participants received delayed feedback in the culture norm learning task—participants with higher implicit aptitude again did not exhibit greater improvement across successive trials.

The present findings suggest a revision to the current model of culture learning within the field of acculturation, which posits that people's aptitude for identifying and being aware of social interaction norms is a key determinant of intercultural adjustment (Masgoret & Ward, 2006; Ward et al., 2001; Ward & Geeraert, 2016). This assumption is the basis for many cultural adaptation tools, such as the culture assimilator (Butterfield et al., 2005, in which people are trained to make culturally appropriate attributions for surprising behavior. Instead, our findings suggest that people's aptitude to pick up complex associations in environmental stimuli is a key determinant of how much they improve from trial-and-error experience when learning the social interaction norms of the new culture. Our findings suggest that culture learning theory needs to be expanded to consider the role of implicit aptitude in culture learning, particularly because many cultural patterns are complex and nuanced and cannot be easily verbalized in the form of *dos and don'ts* (Adams & Markus, 2004).

Our findings contribute to the implicit learning literature by showing that implicit aptitude is not only relevant when people learn new information incidentally and are not aware of the information learned—it is also relevant when people are actively trying to learn new information and are likely ultimately aware of the information learned. In traditional measures of implicit learning (e.g., the artificial grammar learning task and the serial reaction time task), people learn the underlying rules incidentally without actively trying to do so, and often are not aware of the underlying rules at the end of the task even if they performed fairly well. In contrast, in all our studies, participants were actively trying to learn the norms governing culturally appropriate social interactions, and in Studies 4-6, debrief sessions indicated that many participants could verbalize the underlying norm. Nevertheless, we found that under certain conditions, participants with higher implicit aptitude exhibit greater improvement from trial-and-error experience even when they were actively trying to learn the norm. Consistent with the arguments of Frensch and Rünger (2003), our findings suggest that incidental learning and lack of awareness of the information learned might not be necessary features of tasks in which implicit aptitude is implicated.

Further, our research contributes to the literature on implicit aptitude by documenting that implicit aptitude predicts how much people improve with trial-and-error experience when learning new social interaction norms. This literature has predominantly focused on the implications of implicit aptitude for second language learning (e.g., Kaufman et al., 2010; Siegelman & Frost, 2015). However, our findings suggest that implicit aptitude plays a much bigger role in everyday life beyond second language learning—it is associated with the speed with which people learn to navigate complex social interactions. Future research can investigate more diverse settings in which implicit aptitude plays a key role in predicting the speed with which people learn new information.

The current research builds on increasing interest in *implicit acculturation*, the idea that newcomers to a culture, such as immigrants, adjust not only in their explicit attitudes and group identifications, but also in their patterns of emotion and personality (see Mesquita et al., 2019, for a review). For example, the more immigrants engaged with the host culture, the greater the match between (a) the extent to which they experienced a range of emotions and (b) the average extent to which host nationals experienced the same emotions (De Leersnyder et al., 2011). The longer immigrants had lived in the host culture, the greater the match of their personality traits to those of locals (Güngör et al., 2013). Although our methods do not allow us to incontrovertibly conclude that people learn the norms of a new culture implicitly, they do show that people's implicit aptitude plays a key role in how much they improve with trial-and-error feedback when learning social interaction norms of a new culture. Overall, the findings are consistent with the proposition that implicit processes play a key role in behavioral acculturation.

Our studies generally found that people with higher explicit aptitude (i.e., IQ) did not exhibit greater improvement over successive trials when learning foreign culture norms, consistent with findings from the expatriation literature. Although IQ is the strongest predictor of job performance (Ree et al., 1994), expatriates' adjustment and effectiveness in new cultures are not predicted by their IQ once other factors are controlled for (Morris et al., 2014a, 2014b). Further, people high in IQ were slower at learning cultural skills through imitation under certain experimental conditions (Muthukrishna et al., 2016).

With reference to the ecological validity of the current findings, we know that foreign exchange students' performance on the task used in our Studies 1 to 3 predicts their subsequent self-reported acculturation with social interactions in a new culture (Madan et al., 2018). However, we do not have any data showing a direct association between foreign exchange students' or expatriates' implicit aptitude and the extent to which they learn social interaction norms of the host culture from trial-and-error feedback. Future research can examine this question. A challenge for this research would be to isolate learning of the social interaction norms of the host culture from emotional reactions experienced while in the host culture.

A key limitation of the current research is that we focused only on one aspect of the cycle by which culture and psyche mutually constitute each other: how people learn cultural patterns (Adams & Markus, 2001, 2004; Fiske et al., 1998). Although the current research did not study the processes by which people reproduce or alter existing cultural patterns (Cohen, 2001; Morling & Lamoreaux, 2008), the findings have implications for cultural change. It is likely that cultural patterns that people learn explicitly are reproduced with high fidelity as people likely have a relatively clear mental representation of the cultural pattern (e.g., as in the supraliminal feedback condition and the consistent feedback condition of our Studies 5 and 6). But cultural patterns that people learn implicitly might be reproduced with lower fidelity (e.g., as in the subliminal feedback and inconsistent feedback conditions of our Studies 5 and 6). To the extent cultural patterns are reproduced imperfectly, it might be harder to identify, define, challenge, and change them. Future research can examine the dynamics of cultural change with reference to cultural patterns that people tend to learn through predominantly implicit or predominantly explicit processes.

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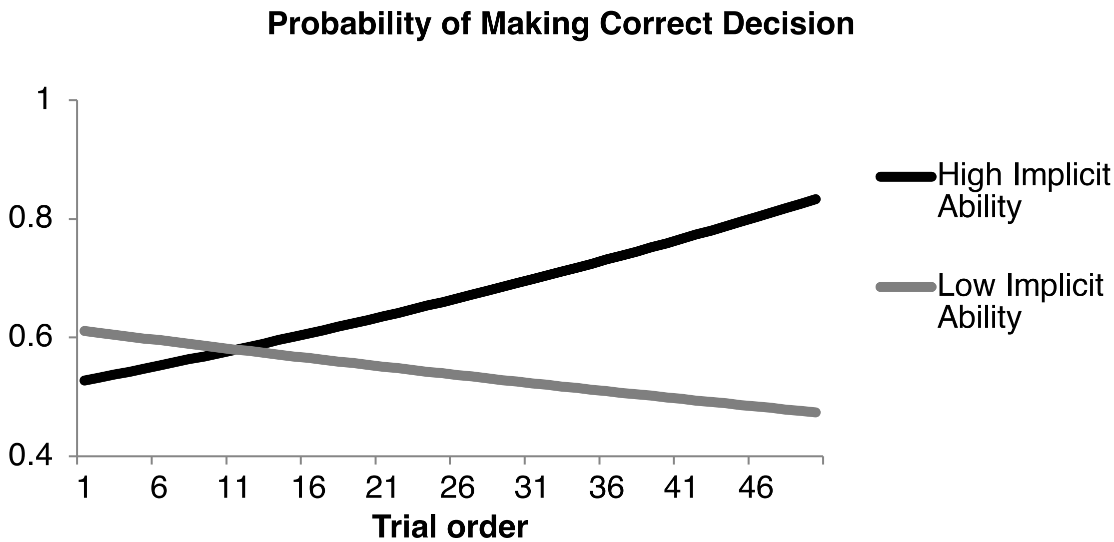
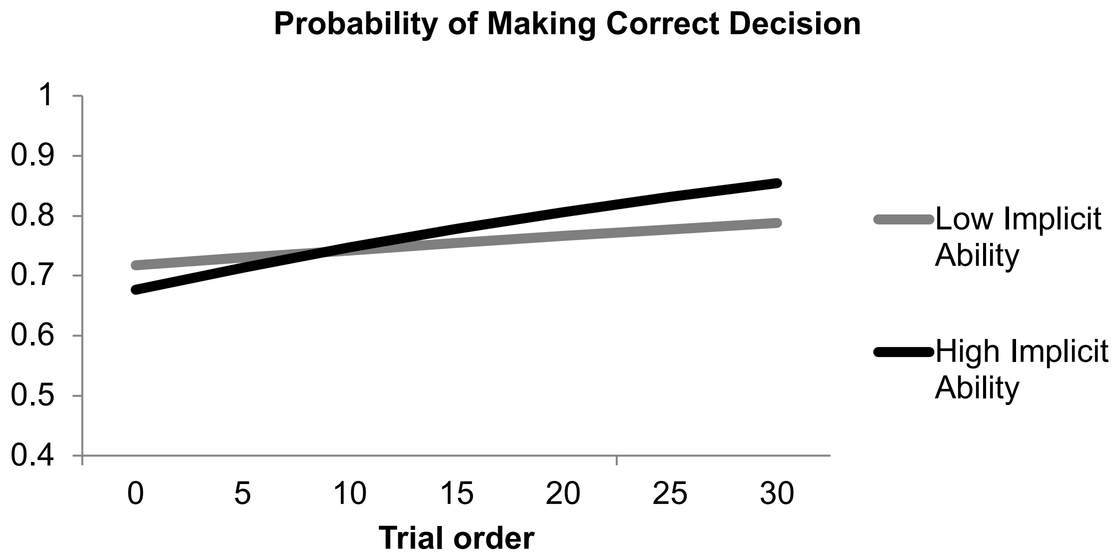
Figures

Figure 2. Hierarchical logistic regression simple slopes on implicit ability in Study 1.



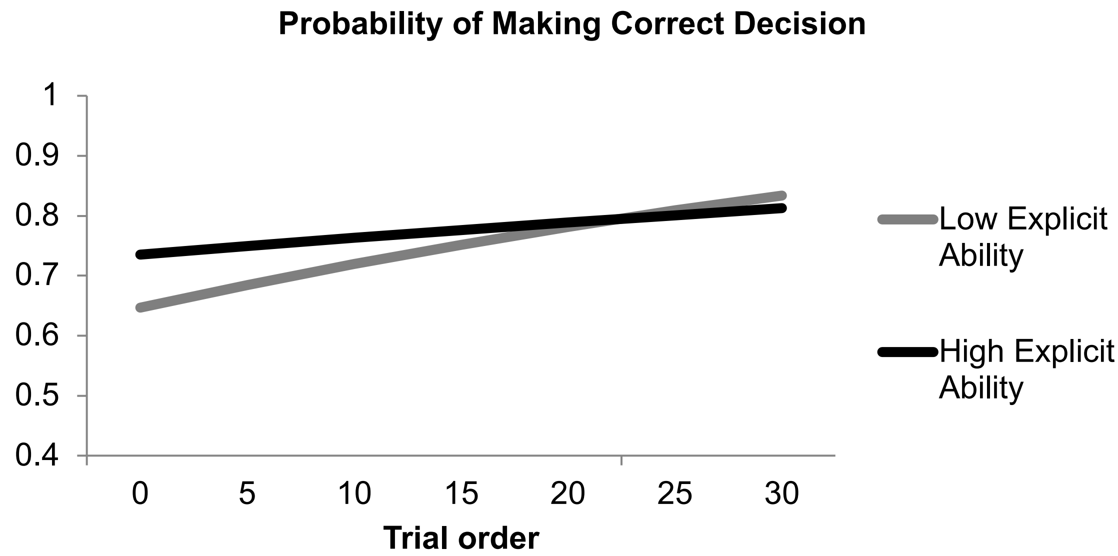
In Study 1, Indian participants' probability of making culturally appropriate decisions in the Americans situations, from log-odds coefficients of the hierarchical logistic model, at one standard deviation above and below the mean on **implicit ability**.

Figure 3a. Hierarchical logistic regression simple slopes on implicit ability in Study 2.



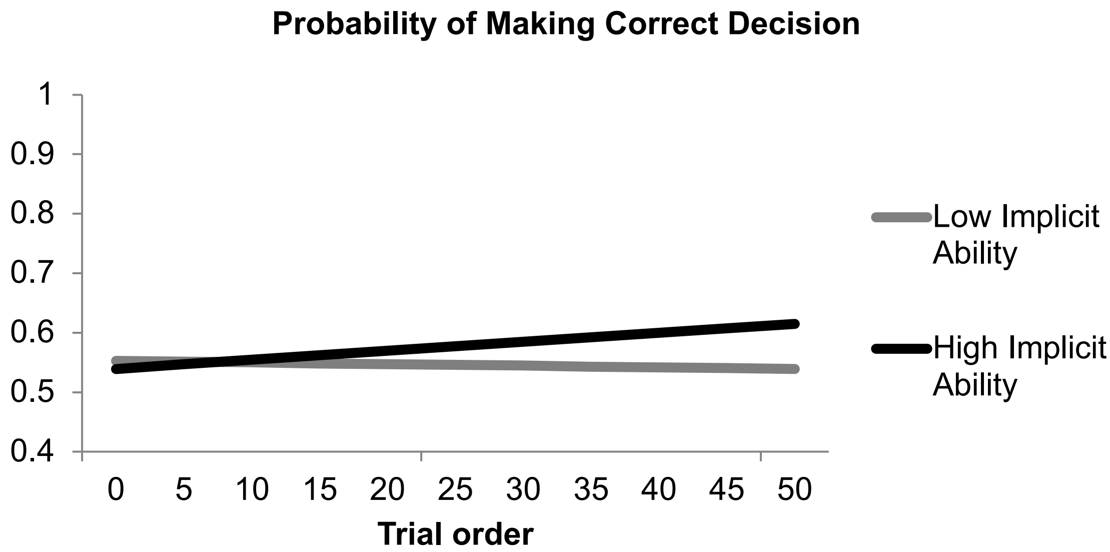
In Study 2, American participants' probability of making culturally appropriate decisions in Indian situations, from log-odds coefficients of the hierarchical logistic model, at one standard deviation above and below the mean on **implicit ability** (controlling for explicit ability).

Figure 3b. Hierarchical logistic regression simple slopes on explicit ability in Study 2.



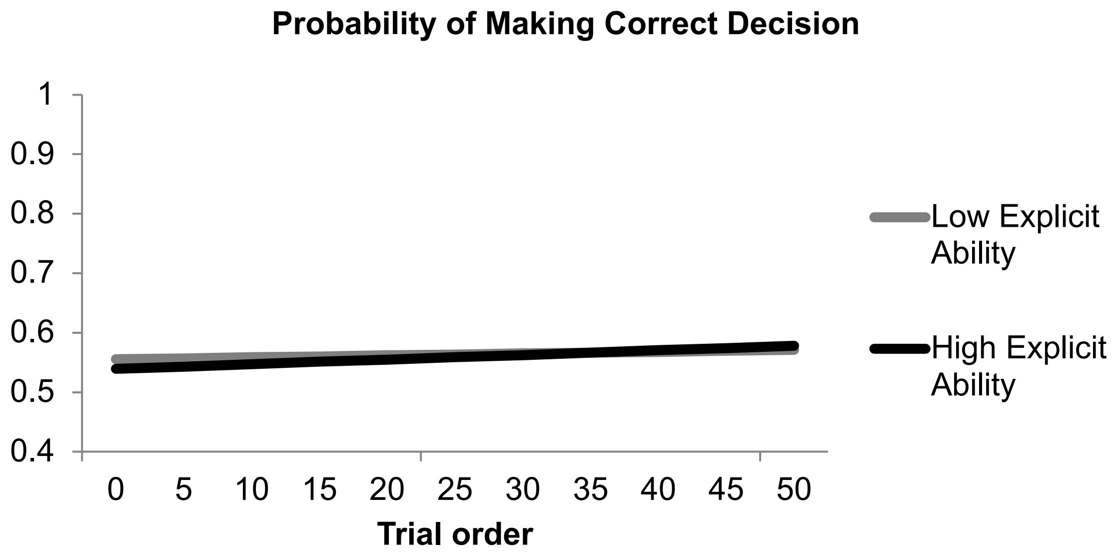
In Study 2, American participants' probability of making culturally appropriate decisions in Indian situations, from log-odds coefficients of the hierarchical logistic model, at one standard deviation above and below the mean on **explicit ability** (controlling for implicit ability).

Figure 4a. Hierarchical logistic regression simple slopes on implicit ability in Study 3.



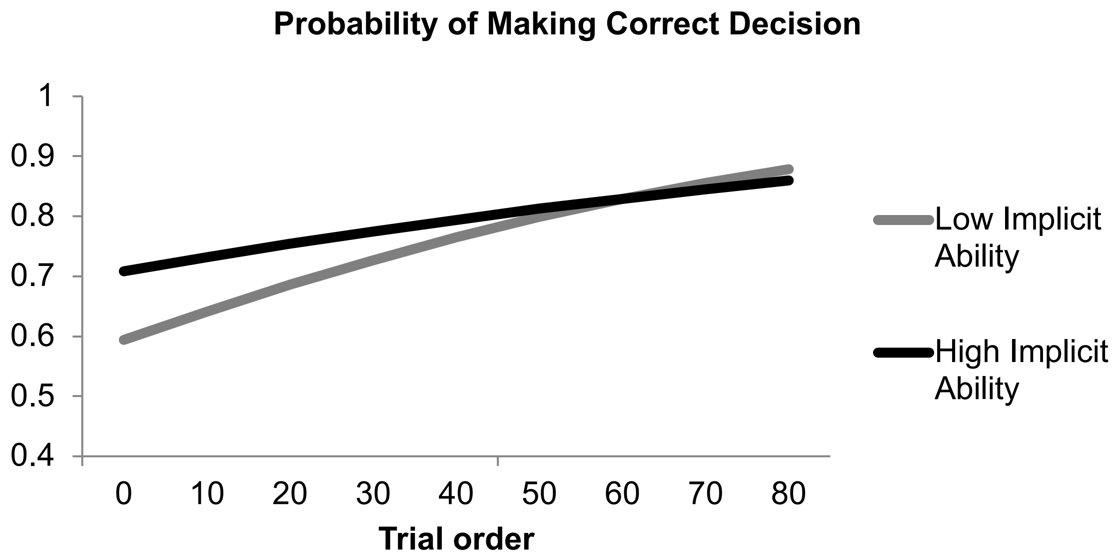
In Study 3, Singaporean participants' probability of making culturally appropriate decisions in American situations, from log-odds coefficients of the hierarchical logistic model, at one standard deviation above and below the mean on **implicit ability** (controlling for explicit ability).

Figure 4b. Hierarchical logistic regression simple slopes on explicit ability in Study 3.



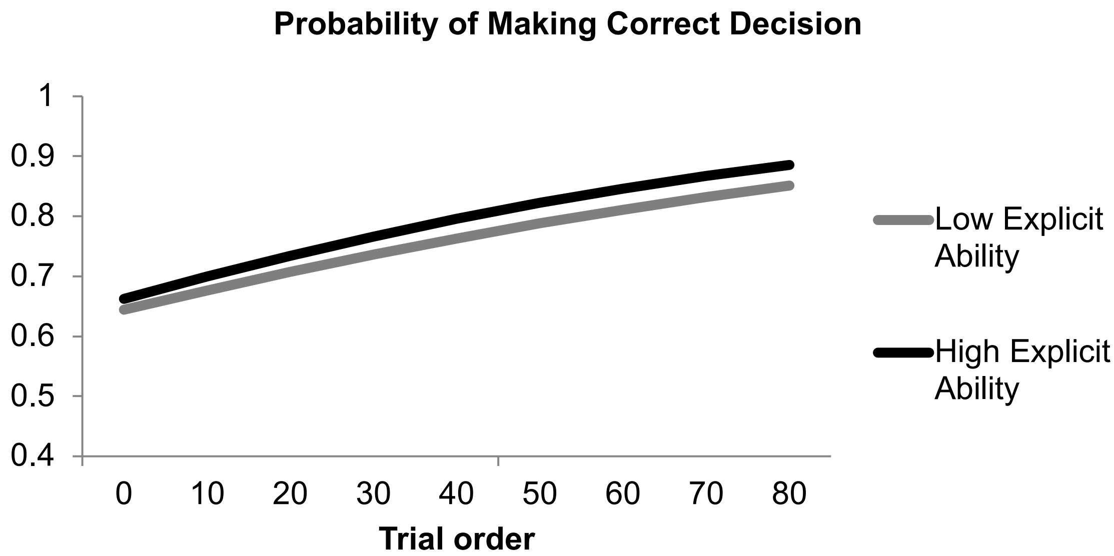
In Study 3, Singaporean participants' probability of making culturally appropriate decisions in American situations, from log-odds coefficients of the hierarchical logistic model, at one standard deviation above and below the mean on **explicit ability** (controlling for implicit ability).

Figure 5a. Hierarchical logistic regression simple slopes on implicit ability in the single-cue condition in Study 4.



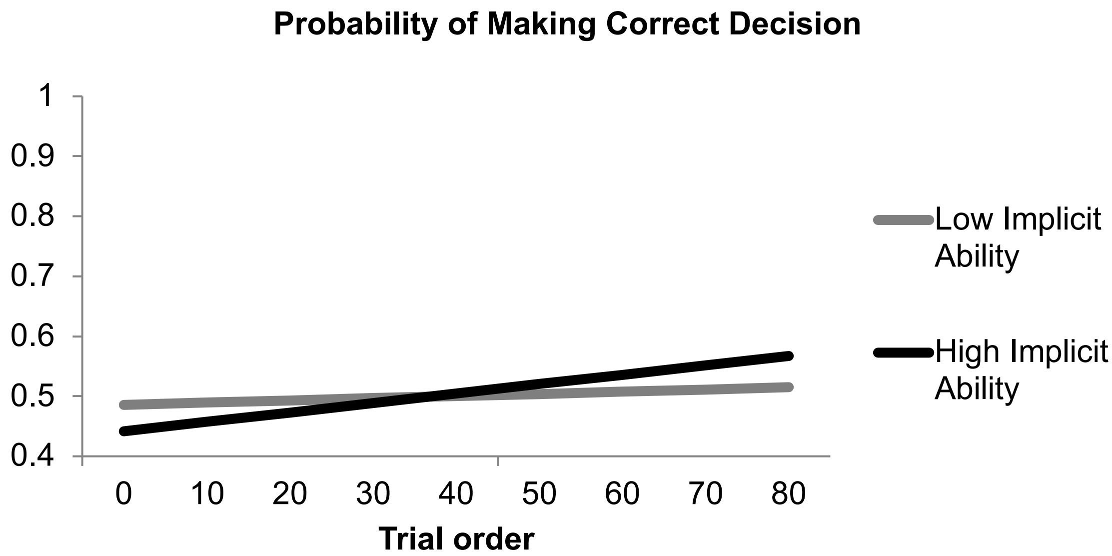
In Study 4, participants' probability of making culturally appropriate decisions in the **single-cue condition**, from log-odds coefficients of the hierarchical logistic model, at one standard deviation above and below the mean on **implicit ability** (controlling for explicit ability).

Figure 5b. Hierarchical logistic regression simple slopes on explicit ability in the single-cue condition in Study 4.



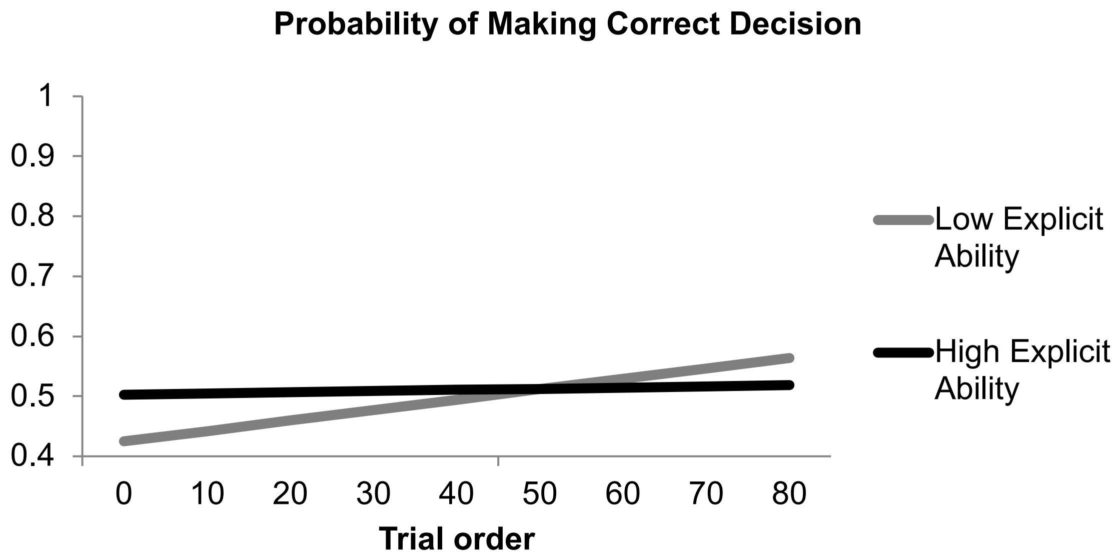
In Study 4, participants' probability of making culturally appropriate decisions in the **single-cue condition**, from log-odds coefficients of the hierarchical logistic model, at one standard deviation above and below the mean on **explicit ability** (controlling for implicit ability).

Figure 5c. Hierarchical logistic regression simple slopes on implicit ability in the multi-cue condition in Study 4.



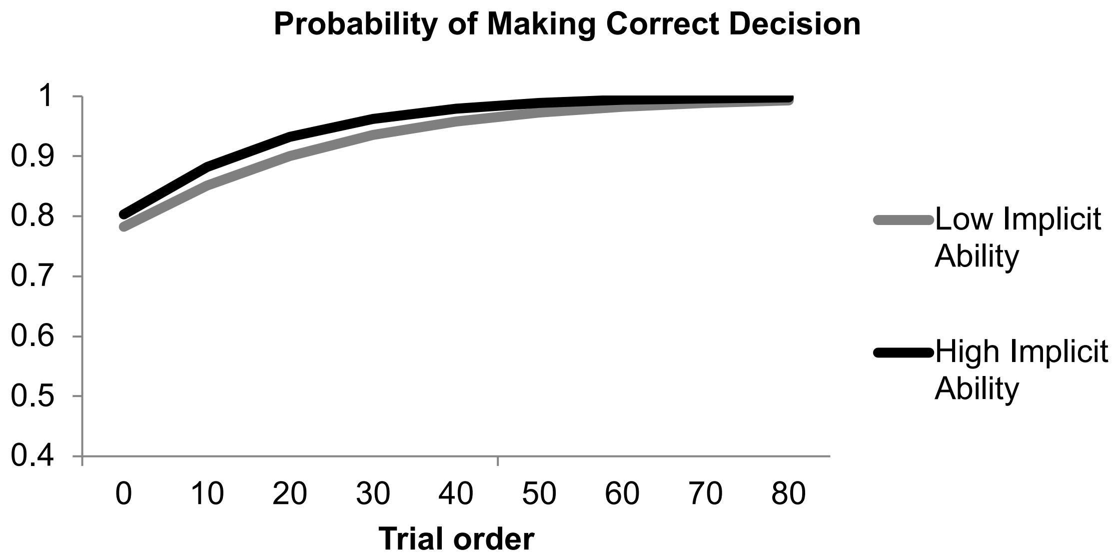
In Study 4, participants' probability of making culturally appropriate decisions in the **multi-cue condition**, from log-odds coefficients of the hierarchical logistic model, at one standard deviation above and below the mean on **implicit ability** (controlling for explicit ability).

Figure 5d. Hierarchical logistic regression simple slopes on explicit ability in the multi-cue condition in Study 4.



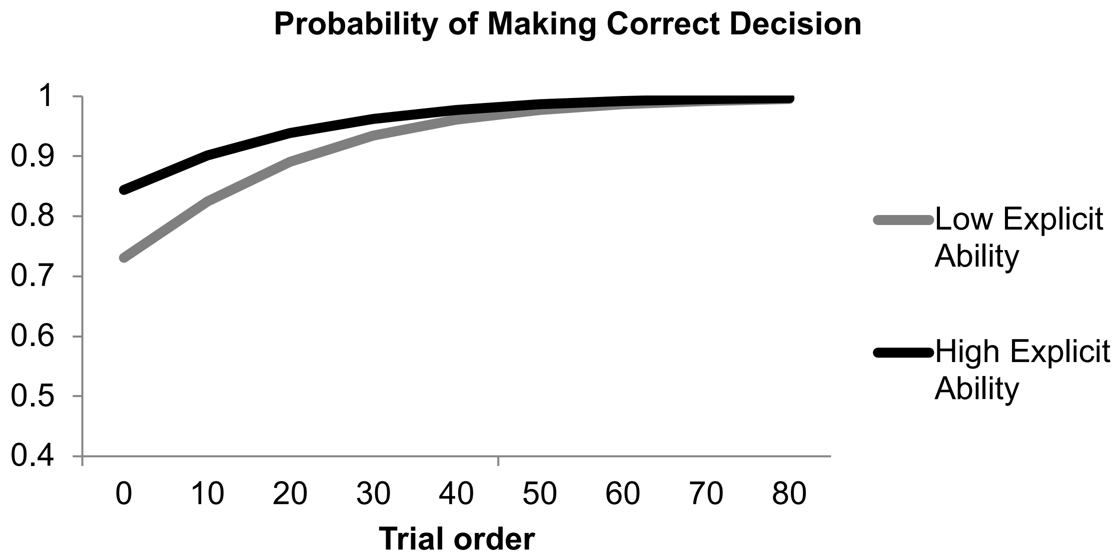
In Study 4, participants' probability of making culturally appropriate decisions in the **multi-cue condition**, from log-odds coefficients of the hierarchical logistic model, at one standard deviation above and below the mean on **explicit ability** (controlling for implicit ability).

Figure 6a. Hierarchical logistic regression simple slopes on implicit ability in the supraliminal feedback condition in Study 5.



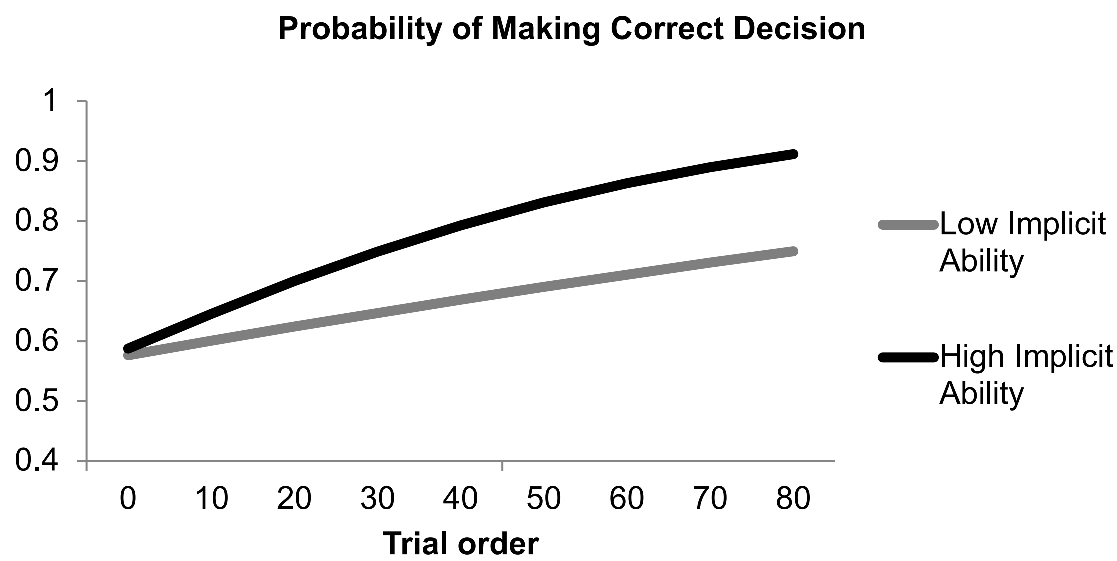
In Study 5, participants' probability of making culturally appropriate decisions in the **supraliminal feedback condition**, from log-odds coefficients of the hierarchical logistic model, at one standard deviation above and below the mean on **implicit ability** (controlling for explicit ability).

Figure 6b. Hierarchical logistic regression simple slopes on explicit ability in the supraliminal feedback condition in Study 5.



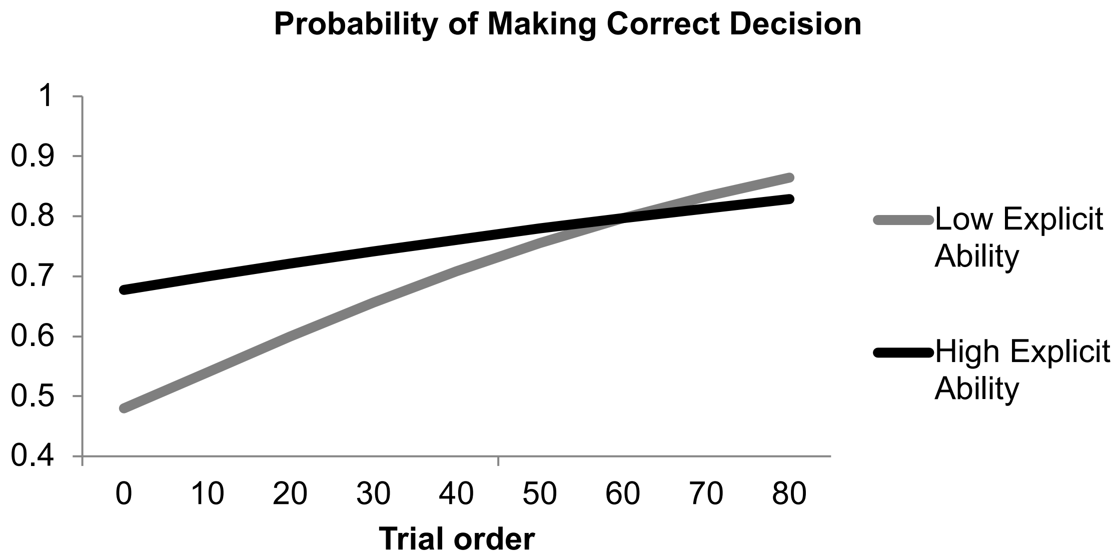
In Study 5, participants' probability of making culturally appropriate decisions in the **supraliminal feedback condition**, from log-odds coefficients of the hierarchical logistic model, at one standard deviation above and below the mean on **explicit ability** (controlling for implicit ability).

Figure 6c. Hierarchical logistic regression simple slopes on implicit ability in the subliminal feedback condition in Study 5.



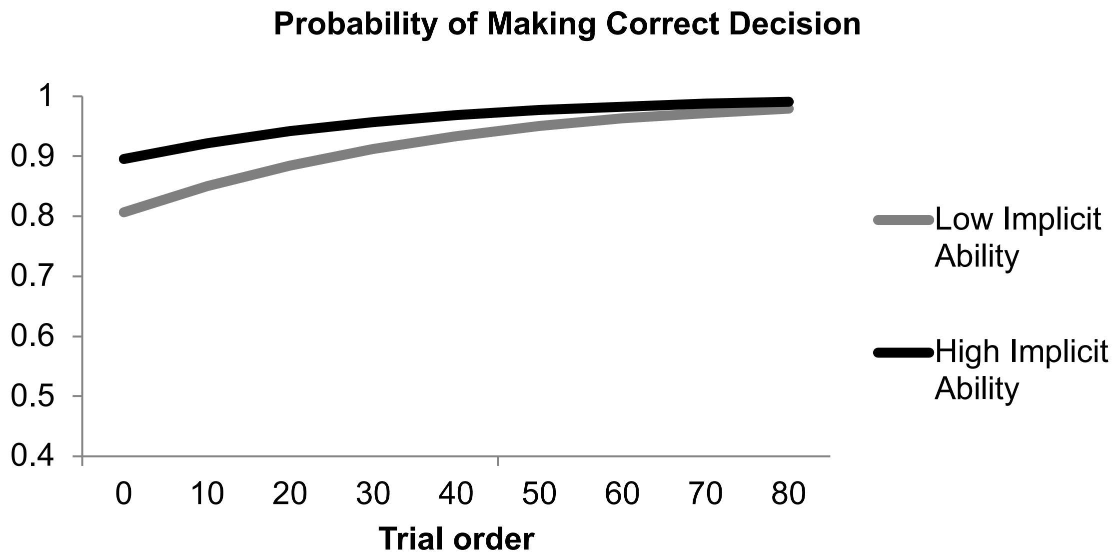
In Study 5, participants' probability of making culturally appropriate decisions in the **subliminal feedback condition**, from log-odds coefficients of the hierarchical logistic model, at one standard deviation above and below the mean on **implicit ability** (controlling for explicit ability).

Figure 6d. Hierarchical logistic regression simple slopes on explicit ability in the subliminal feedback condition in Study 5.



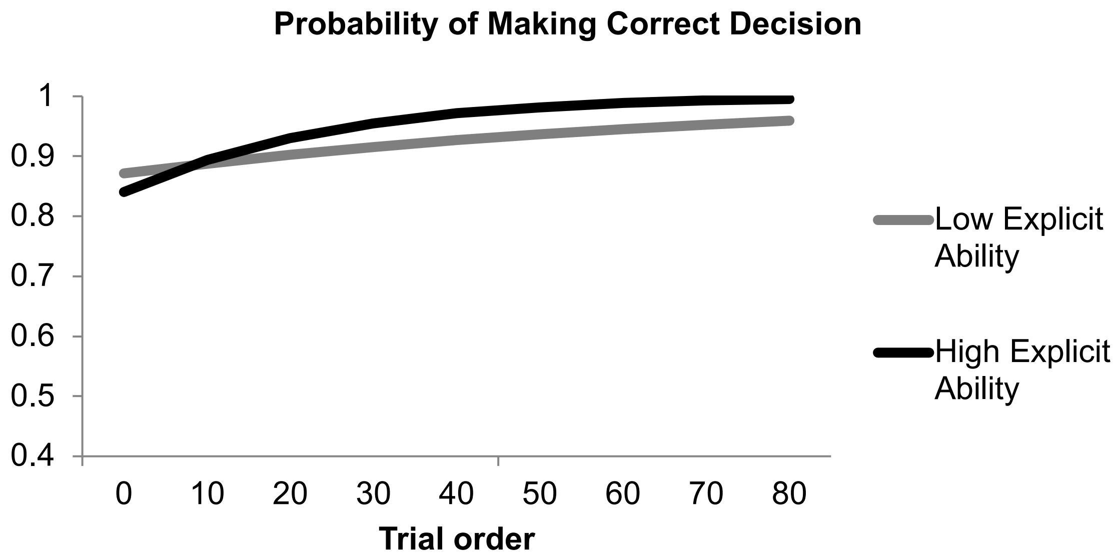
In Study 5, participants' probability of making culturally appropriate decisions in the **subliminal feedback condition**, from log-odds coefficients of the hierarchical logistic model, at one standard deviation above and below the mean on **explicit ability** (controlling for implicit ability).

Figure 7a. Hierarchical logistic regression simple slopes on implicit ability in the consistent feedback condition in Study 6.



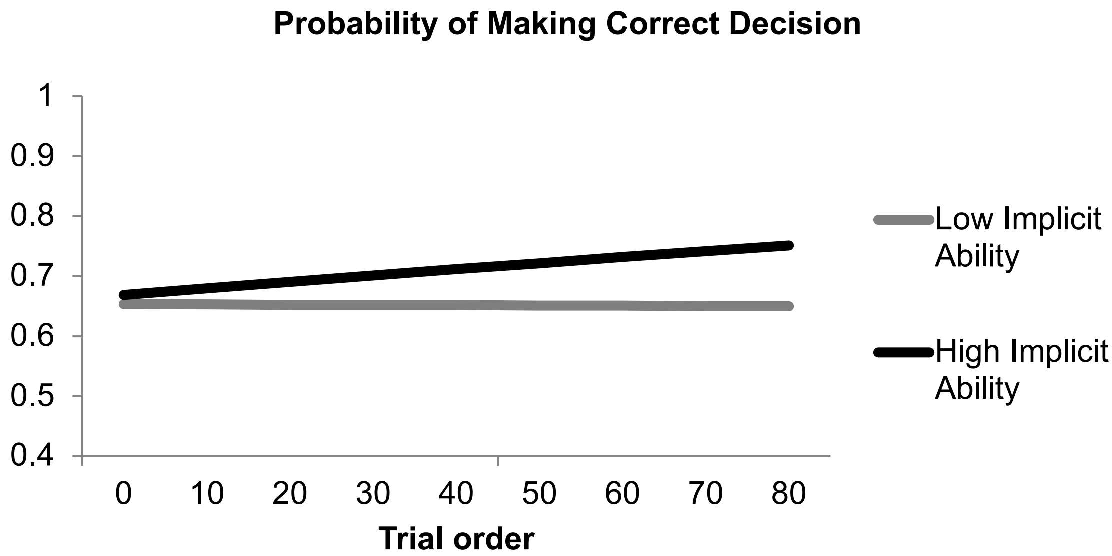
In Study 6, participants' probability of making culturally appropriate decisions in the **consistent feedback condition**, from log-odds coefficients of the hierarchical logistic model, at one standard deviation above and below the mean on **implicit ability** (controlling for explicit ability).

Figure 7b. Hierarchical logistic regression simple slopes on explicit ability in the consistent feedback condition in Study 6.



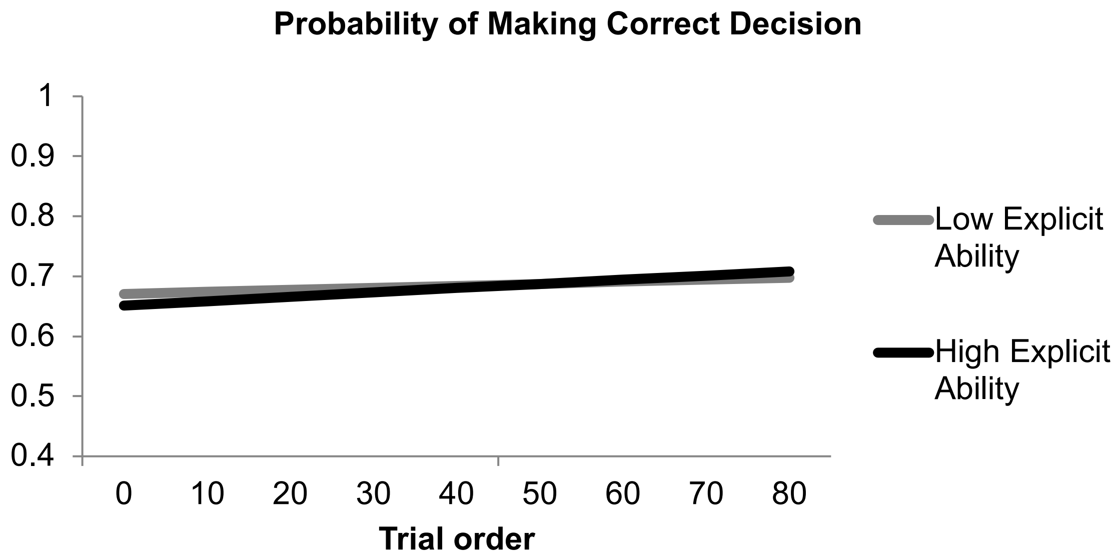
In Study 6, participants' probability of making culturally appropriate decisions in the **consistent feedback condition**, from log-odds coefficients of the hierarchical logistic model, at one standard deviation above and below the mean on **explicit ability** (controlling for implicit ability).

Figure 7c. Hierarchical logistic regression simple slopes on implicit ability in the inconsistent feedback condition in Study 6.



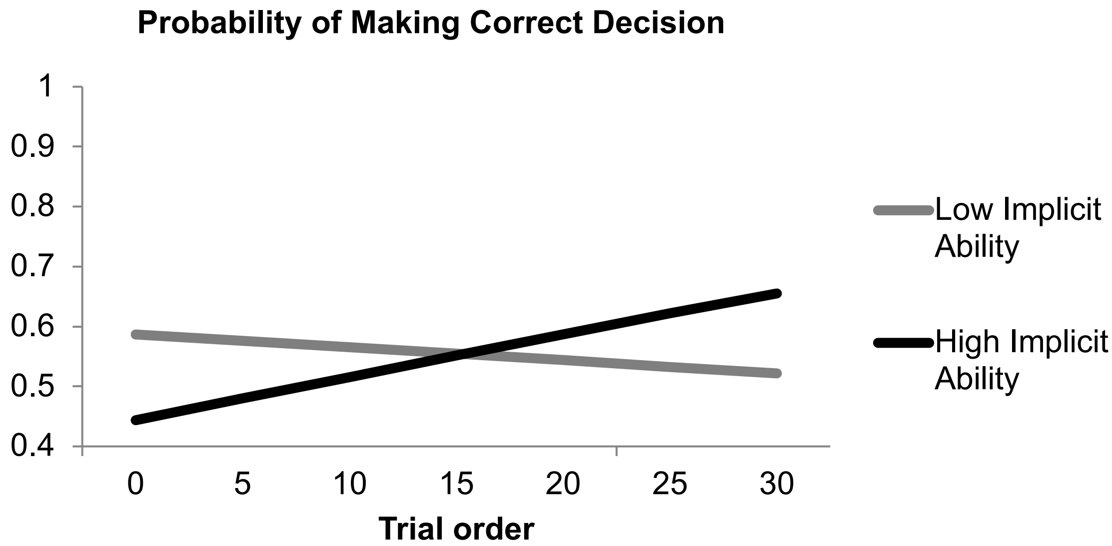
In Study 6, participants' probability of making culturally appropriate decisions in the **inconsistent feedback condition**, from log-odds coefficients of the hierarchical logistic model, at one standard deviation above and below the mean on **implicit ability** (controlling for explicit ability).

Figure 7d. Hierarchical logistic regression simple slopes on explicit ability in the inconsistent feedback condition in Study 6.



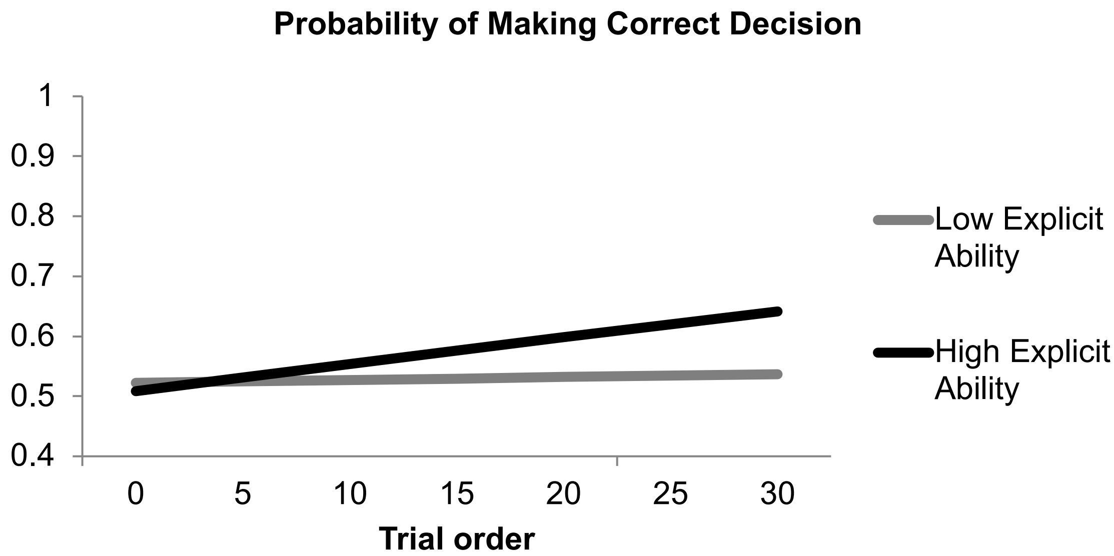
In Study 6, participants' probability of making culturally appropriate decisions in the **inconsistent feedback condition**, from log-odds coefficients of the hierarchical logistic model, at one standard deviation above and below the mean on **explicit ability** (controlling for implicit ability).

Figure 8a. Hierarchical logistic regression simple slopes on implicit ability in the immediate feedback condition in Study 7.



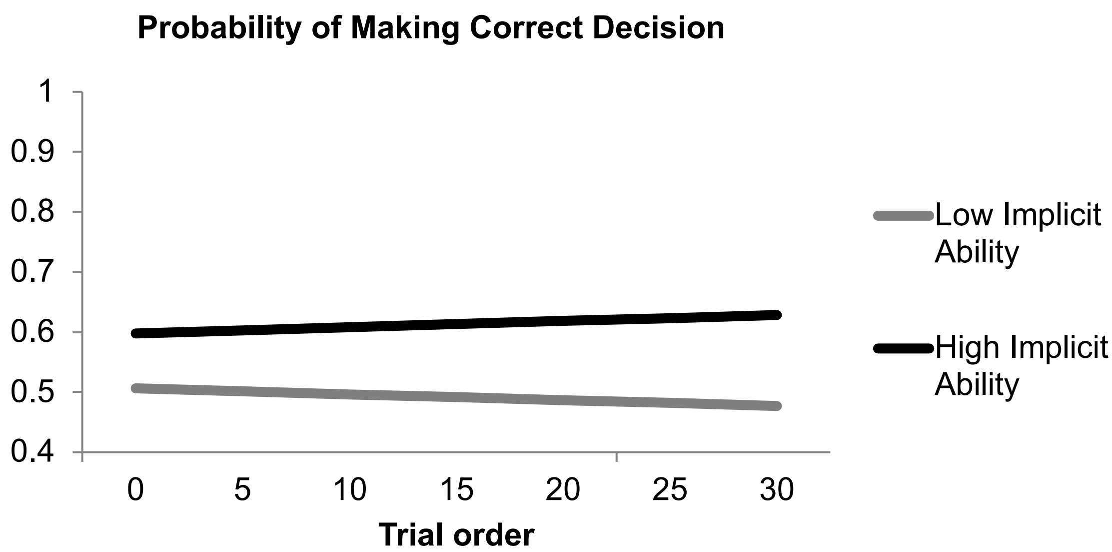
In Study 7, participants' probability of making culturally appropriate decisions in the **immediate feedback condition**, from log-odds coefficients of the hierarchical logistic model, at one standard deviation above and below the mean on **implicit ability** (controlling for explicit ability).

Figure 8b. Hierarchical logistic regression simple slopes on explicit ability in the immediate feedback condition in Study 7.



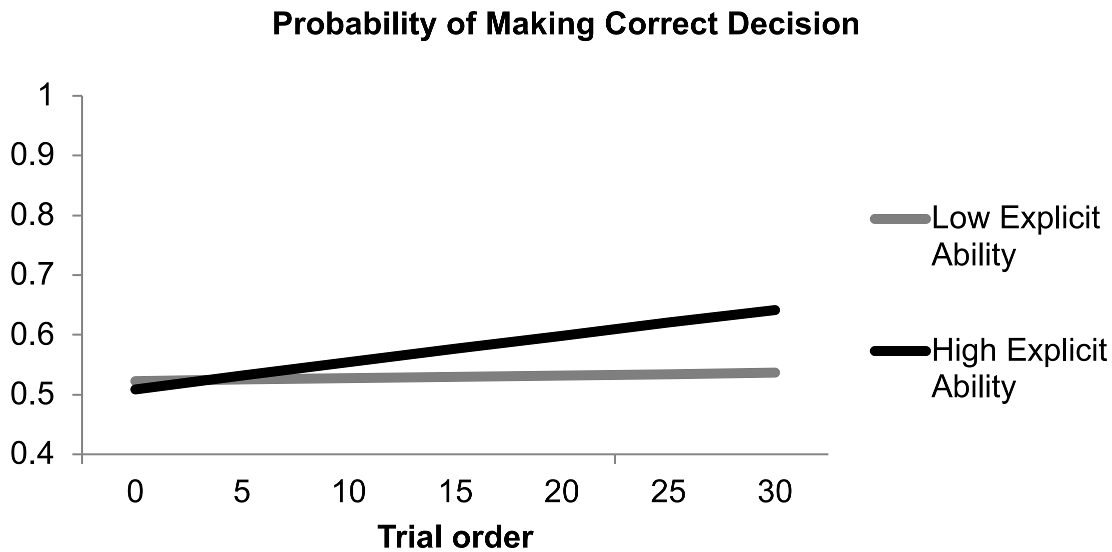
In Study 7, participants' probability of making culturally appropriate decisions in the **immediate feedback condition**, from log-odds coefficients of the hierarchical logistic model, at one standard deviation above and below the mean on **explicit ability** (controlling for implicit ability).

Figure 8c. Hierarchical logistic regression simple slopes on implicit ability in the delayed feedback condition in Study 7.



In Study 7, participants' probability of making culturally appropriate decisions in the **delayed feedback condition**, from log-odds coefficients of the hierarchical logistic model, at one standard deviation above and below the mean on **implicit ability** (controlling for explicit ability).

Figure 8d. Hierarchical logistic regression simple slopes on explicit ability in the delayed feedback condition in Study 7.



In Study 7, participants' probability of making culturally appropriate decisions in the **delayed feedback condition**, from log-odds coefficients of the hierarchical logistic model, at one standard deviation above and below the mean on **explicit ability** (controlling for implicit ability).