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Cultural Variations in Memory Disruption: The Part-List Cuing Impairment in Taiwan, Singapore, and the United States

Nicholas W. Pepe[1*], Lishi Tan[2*], Tsung-Ren Huang[3], Krishna Savani[4], and Suparna Rajaram[1]

Abstract

This research examines the cultural generalizability of a well-established memory phenomenon, the part-list cuing impairment, in which people who receive a subset of a studied list as hints recall fewer items than those who do not. Extensive research conducted in North America and Europe has documented this impairment. Our investigation focused on competing hypotheses about possible cultural differences in this impairment. The first hypothesis was that the part-list cue impairment in recall is a culturally universal memory phenomenon (i.e., it is not modulated by culture). The second hypothesis focused on possible differences in part-list cuing impairment rooted in cultural differences in analytic versus holistic processing styles. Contrary to both hypotheses, our results indicated that the part-list cuing impairment was similarly strong in the United States and Taiwan, cultures that can both be considered relatively less multicultural. In contrast, the part-list cuing impairment was weaker among ethnic Chinese participants in Singapore, a culture that can be considered relatively more multicultural. The highly influential analytic-holistic cognition distinction, which would predict that ethnic Chinese in Singapore and Taiwan would be similar to each other but different from Americans, cannot account for these findings. Instead, we consider possible alternative explanations, such as the idea that multiculturalism might shape basic memory processes that are assumed to be culturally universal. Overall, this research highlights the importance of exploring psychological phenomena in cross-cultural psychology beyond two-culture comparisons and beyond the dominant paradigms for explaining East-West differences in cognition.

[1]Stony Brook University, NY, USA
[2]University of Leeds, UK
[3]National Taiwan University, Taipei
[4]The Hong Kong Polytechnic University, Kowloon

*NP and LT contributed equally and are joint first authors.

Corresponding Authors:

Krishna Savani, The Hong Kong Polytechnic University, Li Ka Shing Tower M857, Hung Hom, Kowloon, Hong Kong.
Email: krishna.savani@polyu.edu.hk

Suparna Rajaram, Department of Psychology, Stony Brook University, Stony Brook, NY 11794-2500, USA.
Email: suparna.rajaram@stonybrook.edu

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For decades, there has been recognition that cultural variations can modulate cognitive performance (Bartlett, 1932; Ebbinghaus, 1885). However, research addressing the influence of cultural variations on cognition has lagged (Barrett, 2020; Gutchess & Rajaram, 2023; Q. Wang, 2016) and so far largely assumed that cognitive processes are universal (Shepard, 1987). Recent research addressing the role of culture has begun to demonstrate that even some basic cognitive processes, such as perception, attention, and memory, are culturally shaped (Boduroglu et al., 2009; Chua et al., 2005; Masuda & Nisbett, 2001; Q. Wang, 2021). In the current research, we assessed the cultural generalizability of the part-list cuing impairment in recall (Slamecka, 1968). Past-list cuing impairment is a robust memory phenomenon that provides a window into the nature of retrieval and thus is central to the memory literature.

The Part-List Cuing Impairment

The part-list cuing impairment refers to a counterintuitive finding in the memory literature. Participants first study a list of to-be-remembered words and later recall those words. Those in the part-list cued condition are provided with a subset of the studied words (or "part-list cues") meant to *aid* recall. Yet, some research has found that participants provided with part-list cues recall *fewer* remaining words than the participants who were not provided with cues (Basden et al., 1977; Slamecka, 1968), a phenomenon now referred to as the part-list cuing impairment. This finding runs contrary to more intuitive ones that suggest presenting a category's name should improve recall (Tulving, 1974).

Several explanations for the part-list cuing impairment have been proposed since it was first reported in 1968 (see Nickerson, 1984; Pepe et al., 2023 for reviews). One prominent account, retrieval disruption, focuses on participants' strategies for organizing the recall of studied information. The presence of part-list cues is assumed to disrupt the organizational structure or the sequence in which studied items are recalled by each participant, and this disruption reduces people's ability to retrieve the remaining items (Basden et al., 1977). This hypothesis is supported by the findings of an increase in recall of the non-cued (also referrred to as "critical") items in a later free recall in which the part-list cues are no longer present, such that participants can use their own retrieval strategies undisturbed (Basden & Basden, 1995; Roediger et al., 1977). For example, given a list of to-be-remembered items, such as various sports, a person's organization of that list is likely unique, differing from person to person. If supplied with a list containing the words "baseball," "lacrosse," "tennis," "water polo," and "hockey," a person may organize the list alphabetically, based on which sports they find entertaining to watch, or based on which sports they have actively engaged in. The order in which a person stores this list in memory is thus idiosyncratic. When asked to recall the list of sports, the first item recalled may be "tennis" for a tennis fan or "hockey" for a hockey player. However, when provided with a part-list cue, such as "water polo," the individual's default retrieval strategy is disrupted, and the part-list cue can trigger a different item being recalled than what they would have recalled in the absence of the cue. This disruption culminates in a reduced recall of the studied items.

Yet, many findings cannot be explained by this hypothesis but are well explained by another prominent mechanism, namely retrieval inhibition (Aslan & Bäuml, 2007, 2009). The proposed mechanism of retrieval inhibition suggests that part-list cues during retrieval can strengthen the memory representations of those items and, consequently, suppress the

remaining ones. This results in the non-cued items being functionally unavailable during recall. This hypothesis can explain why participants' performance on subsequent free recall sometimes remains diminished even after the part-list cues are removed (Bäuml & Aslan, 2006; Muntean & Kimball, 2012). Together, a two-mechanism account of retrieval disruption and retrieval inhibition offers a good explanation for the findings (Lehmer & Bäuml, 2018a). These competing mechanisms highlight memory researchers' interest in the part-list cuing impairment, making it suitable to explore this phenomenon across cultures. Although a focus on these cognitive mechanisms is important, in the present research, we sought to first establish the cultural generalizability of the phenomenon.

The part-list cuing impairment has been repeatedly demonstrated in North America and Europe (e.g., Barber & Rajaram, 2011; Dagnall et al., 2007; Garrido et al., 2012; Lehmer & Bäuml, 2018a, 2018b). A few studies conducted in China and Japan have also replicated the impairment (Liu & Bai, 2017; Takahashi, 2013; Takahashi & Kawaguchi, 2011; Yamada, 2009) and found effect sizes ranging from Cohen's $d = .30$ to .59 (see Supplemental Materials). However, we could not identify any study directly comparing the magnitude of this impairment across cultures using identical materials and procedures. Given the complexity of the phenomenon and the sensitivity of this impairment to a large range of experimental conditions (such as the inter-item association among the study items, the order in which cues are presented, and the amount of time between encoding and retrieval; see Pepe et al., 2023 for a review), a controlled cross-cultural comparison is essential to assess whether there might be differences in the part-list cuing impairment across cultures based on predominant cognitive processing styles.

Cultural Differences in Cognition

Research on human memory has been primarily conducted with people from Western, Educated, Industrialized, Rich, and Democratic societies (WEIRD; Henrich et al., 2010; Q. Wang, 2016, 2021). Recent psychological research is moving away from this practice to explore the extent to which cultural factors shape cognition (e.g., Nisbett et al., 2001; Q. Wang, 2016). In this context, a prominent discovery of cultural differences in cognition is processing style—individuals from Eastern cultures tend to use a more holistic processing style, whereas those in Western cultures tend to use a more analytical processing style (Chua et al., 2005; Masuda & Nisbett, 2001; Nisbett et al., 2001).

The main differences between the two styles are whether people pay more attention to focal versus background information and whether people focus on attributes of the focal information itself versus the relationships between pieces of information (Miyamoto, 2013). Those with a holistic processing style tend to focus on the relationships between the items they are processing and group information based on their shared relationships (Ji et al., 2001; Norenzayan et al., 2002). By contrast, people with an analytic processing style tend to emphasize differences among the items and categories or shared features to group items (Gutchess et al., 2006; Ji et al., 2001; Norenzayan et al., 2002). For example, Chinese people are more likely to group words such as "cow" and "grass" together (relational; "cow eats grass"), whereas Americans are more likely to group words such as "cow" and "donkey" together based on their functional categories (Ji et al., 2004). The type of processing style can result in differences in people's strategies to process and retrieve information. To illustrate, Gutchess et al. (2006) found that older East Asian adults are less likely to use categories when recalling memorized items than older American adults.

Cross-cultural research in psychology has largely focused on two-culture comparisons, typically one Western culture (in North America or Europe) and one Eastern culture (in Asia). Nevertheless, the assumption that all Western cultures and all Eastern cultures are similar is not valid (Kitayama et al., 2022). Although numerous studies of the part-list cuing impairment have

been conducted in various Western cultures (e.g., the United States, Canada, Germany, Italy, Sweden, and the United Kingdom), similar research in Eastern cultures is relatively limited. Furthermore, evidence across Western and Eastern cultures comes from different studies, precluding direct comparisons based on the same design, procedures, and materials. We thus tested, in direct comparisons, whether the part-list cuing impairment would generalize across two Asian cultures—Taiwan and Singapore—and how this phenomenon might manifest differently in these cultures than in a Western culture—the United States. As we have previously discussed, while retrieval disruption and retrieval inhibition are two mechanisms behind the part-list cuing impairment have been tested in the broader literature, our goal in this series of experiments was to step back and first undertake a direct, cross-cultural comparison to examine the presence of this memory phenomenon across cultures in question.

Hypothesis Development

Our main research goal was to provide a direct comparison of the part-list cuing impairment across multiple cultural contexts. As previously mentioned, the part-list cuing impairment has been observed in several cultures, but to our knowledge, no report has directly compared the impairment across cultures in a carefully constructed parallel setup with identical methodology and careful sample considerations.

With this goal in mind, we tested two competing hypotheses guided by the literature on both the part-list cuing impairment and cultural influences on cognition. We built our first hypothesis (H1)—no cultural differences would be observed among our samples—on the assumption that many basic memory processes are universally shared (Shepard, 1987) and past findings that the part-list cuing impairment has been observed in various cultures (e.g., American, Canadian, Chinese, German, Italian, Japanese, Swedish). As there is a paucity of cultural differences being reported in the literature, it is timely to explore this possibility using direct comparisons between cultures that have not been reported before.

Our second hypothesis (H2a) is developed based on prior cultural research in analytic-holistic processing styles while also considering a crucial feature of stimuli typically used in part-list cuing impairment research: categorization. Study items that are often used in tests of the part-list cuing impairment are composed of categories such as fish, birds, and sports (e.g., Aslan & Bäuml, 2009; Barber & Rajaram, 2011; Basden & Basden, 1995; Roediger & Schmidt, 1980). As part-list cues have been hypothesized to interfere with people's memory by either disrupting the idiosyncratic web of items in memory or inhibiting the retrieval of target (i.e., non-cued) items (Lehmer & Bäuml, 2018a), people who organize the items in their memory based on categories might be more susceptible to interference when the part-list cues are also organized by category.

Cross-cultural psychologists have found that people from analytical cultures are more likely to use categories to group words together, whereas those from holistic cultures are more likely to use relationships to do so (Chiu, 1972; Choi et al., 1997; Ji et al., 2004). If people from Asian cultures are more likely to organize information by relationships, they may pay less attention to categorical membership and thus be less affected by cues organized by category. In contrast, if Westerners are more likely to organize information by categories, they may pay more attention to the categorically organized part-list cues and thereby be more impaired by them. This prediction is supported by past part-list cuing research showing that weaker associations between items result in a smaller impairment (Kimball & Bjork, 2002). In other words, in cultures in which the associations between the items within a category are stronger, as is expected in Western cultures more so than Eastern cultures (Ji et al., 2004), we would expect a greater magnitude of memory impairment. As such, we propose that the part-list cuing impairment will be stronger for categorically organized word lists in the United States than in Taiwan and Singapore (H2a).

There is a variation of the second hypothesis that generates a different prediction than H2a. As previously noted, Westerners tend to organize information by category (Ji et al., 2004), and therefore, their idiosyncratic recall is more likely organized by category and less by relationships. In contrast, Asians tend to organize information more by relationships (Ji et al., 2004), so their idiosyncratic recall is less likely to reflect categorical memberships. Imagine that the part-list cues derived from a categorically organized word list are also displayed in groups based on categories. In this case, the presentation of the part-list cues will better match how the participants presumably organized the words in their memory if they rely more on categorization during the encoding phase. When the order of the part-list cues is congruent with the order in which participants organized the stimuli in memory, the magnitude of the part-list cuing impairment diminishes (Basden et al., 2002). This finding suggests the possibility that higher congruency between the presentation of part-list cues and the organization of words in participants' memory during the encoding phase leads to lower impairment. This possibility leads to the prediction that categorical word lists would impair analytic thinkers less than they do for holistic thinkers, as the order of analytic thinkers' idiosyncratic memory organization is more likely to be congruent with the categorical presentation of part-list cues. Thus, we would expect the categorized lists to disrupt the two Asian groups, who are considered holistic processors, more than Americans (Nisbett et al., 2001) (H2b). In sum, both variations of the second hypothesis predict an overall East-West difference in the part-list cuing impairment with no differences between the two Asian groups.

We conducted two studies to test these hypotheses. For both studies, we ensured that all our participants were born in the countries of their respective cultures. This helps to ensure that within each culture, the participants received similar exposure to their native culture. In addition, although Singapore is a multiracial country, we decided to include only ethnic Chinese participants so that our Singaporean sample was more directly comparable to our Taiwanese sample, which was also composed of only ethnic Chinese participants. Study materials, data, and analytic code are available at osf.io/28zht.

Study 1

Study 1 compared the strength of the part-list cuing impairment across American, Singaporean Chinese, and Taiwanese participants.

Method

We report all participants, conditions, and measures. The institutional review board at each university approved the study procedures.

Participants. As we adopted the method of Barber and Rajaram (2011, Experiment 1, control condition), we conducted a power analysis using their effect size Cohen's $d = .46$, $\alpha = .05$ (two-tailed), and power = 80%, which indicated that we needed to recruit a minimum of 152 participants per culture. We recruited 149 undergraduate students from Stony Brook University in the United States (66.44% female; mean age 19.72 years, $SD = 1.92$; all born in the United States), 201 undergraduate students from Nanyang Technological University in Singapore (58.21% female; mean age 21.71 years, $SD = 1.50$; all ethnic Chinese born in Singapore), and 204 undergraduate and graduate students from National Taiwan University (50% female; mean age 23.83 years, $SD = 3.51$; all ethnic Chinese born in Taiwan). We ended up with more participants in Singapore and Taiwan than suggested by the power analysis because the participant show-up rate was higher than anticipated. Five participants from Taiwan were excluded from the analyses as they recalled zero items on the initial recall task, leaving us with 199 participants from Taiwan (50.75% female; mean age 23.90 years, $SD = 3.52$).

Materials and Procedure. The study was conducted in a university behavioral lab in each culture and used identical software programs and procedures across cultures. We conducted the study in English in the United States and Singapore, as English is the official language of education in both countries. We conducted the study in traditional Chinese in Taiwan, as many Taiwanese college students may be unfamiliar with the English vocabulary of the experimental materials.

Participants were randomly assigned to either the free-recall or the part-list cued recall condition. The stimuli consisted of categorized word lists often used in part-list cuing recall (e.g., Aslan & Bäuml, 2009; Barber & Rajaram, 2011; Basden & Basden, 1995; Roediger & Schmidt, 1980). Categorical word lists are also more suited to test our hypotheses than other stimuli, such as unrelated nouns, as people can form memory networks using either category memberships, which analytic processors tend to focus on, or relationships between items within and across categories, which holistic processors tend to focus on (Varnum et al., 2008). We set up our second set of hypotheses (H2a and H2b) based on the argument that U.S. participants should be more inclined toward using an analytic processing style, whereas Taiwanese and Singaporean participants should have a holistic processing style. Hence, with a categorical word list as our stimuli, any difference in the part-list cuing impairment across cultures could likely be traced to differences in their processing styles, which presumably influence how they form their memory networks.

In the initial study phase, participants saw 84 high-frequency exemplars from six categories (fish, birds, instruments, sports, fabrics, and vegetables). We adapted the method closely from Barber and Rajaram (2011) and used their stimuli word list, drawn from categorical word norms of Van Overschelde et al. (2006). The average response frequency of the exemplars was matched across the categories (see Supplemental Materials). The 14 words in each category consisted of seven high-frequency and seven low-frequency exemplars. As using lower-frequency exemplars from each category as part-list cues produces a larger impairment (Bäuml et al., 2002), we designated the seven low-frequency exemplars as non-cued words and the seven high-frequency exemplars as critical words (i.e., noncue words). In addition, as we described earlier, categorical word lists are more suitable to test our hypotheses than other stimuli, such as unrelated nouns, as a person can form memory networks based on either the items' categorical membership or the relationships between items and/or across categories. In the first study phase, participants saw 84 high-frequency exemplars from 6 categories (fish, birds, instruments, sports, fabrics, and vegetables). Having seen on the study list words such as parrot, eagle (belonging to the category "birds"), zucchini, and okra (belonging to the category "vegetables"), a person who mainly forms memory networks using categories might organize parrot and eagle as belonging to the same category of birds. On the other hand, a person who forms memory networks mainly using relationships between items might organize parrot and zucchini based on how a parrot likes to eat zucchini.

Each word was presented individually for three seconds on a computer screen using Microsoft PowerPoint, with three different random presentation orders used across all participants. The words were translated from English to traditional Chinese for the study in Taiwan (see Suppelmental Materials).

Next, as a distractor task, participants watched a 6-minute video of a college student spending a routine evening in his apartment, taken from the work of Savani and colleagues (2010). Half the participants were asked to make a tally mark on a piece of paper to indicate all of the student's choices, and half were asked to make a tally mark whenever the student touched an object. This manipulation did not influence the recall (all p's $> .57$) and thus will not be discussed.

Next, the experimenter gave participants a recall response sheet based on their experimental condition. Participants in the control condition received a blank sheet and were instructed to recall as many studied words as possible in any order. Participants in the part-list cued condition received a sheet formatted as in past studies (Barber & Rajaram, 2011; Basden et al., 2002), with half of the exemplars organized by category displayed on the top half of the sheet. Before recalling the non-cued words, these participants were instructed to view the cues and think of them as

Table 1. Words Recalled in Study 1.

	Part-list cued recall			Free recall		
Country	*N*	*M* (*SD*)	95% *CI*	*N*	*M* (*SD*)	95% *CI*
Critical words in Recall 1						
United States	75	11.51 (5.20)	[10.31, 12.70]	74	13.92 (5.46)	[12.65, 15.18]
Singapore	99	13.53 (4.76)	[12.57, 14.48]	102	13.70 (5.22)	[12.67, 14.72]
Taiwan	97	11.00 (4.89)	[10.01, 11.99]	102	12.88 (5.24)	[11.85, 13.91]
Critical words in Recall 2						
United States	75	13.01 (5.66)	[11.71, 14.32]	74	14.26 (5.77)	[12.92, 15.59]
Singapore	99	15.34 (5.37)	[14.27, 16.41]	102	14.36 (5.78)	[13.23, 15.50]
Taiwan	97	11.59 (4.72)	[10.64, 12.54]	102	13.84 (5.83)	[12.70, 14.99]
Cue words in Recall 2						
United States	75	22.27 (5.94)	[20.90, 23.63]	74	10.62 (4.63)	[9.55, 11.70]
Singapore	99	23.47 (6.17)	[22.24, 24.71]	102	11.31 (5.06)	[10.32, 12.31]
Taiwan	97	22.55 (7.20)	[21.10, 24.00]	102	9.88 (4.39)	[9.02, 10.74]

Note. The descriptive statistics for the number of words recalled in Study 1.

helpful hints. As we report in the Results section, part-list cued participants had superior memory for the cues later on than control participants, demonstrating that they processed these cues. This outcome was equivalent across all three cultures. They were then asked to recall as many words as possible that were not already on the sheet in front of them, in any order. Participants in both conditions had 10 minutes for this task.

Next, participants in both conditions received a blank sheet and were asked to write down the studied words in a second free recall task. This task was designed to check whether the part-list cuing impairment persisted after removing the part-list cues. Participants were given 10 minutes to recall as many studied words as possible, in any order. The experimenter then collected the response sheets, requested participants to complete a brief demographic questionnaire, and finally debriefed them.

Results

Descriptive statistics are reported in Table 1. Our key dependent variable was the number of critical (i.e., non-cued) words participants recalled in each recall round. As this was a count variable within a fixed time period and exhibited overdispersion, we analyzed the data using negative binomial regressions. The independent variables were condition (control = 0, part-list = 1), a Taiwan dummy (Taiwan = 1, United States and Singapore = 0), a Singapore dummy (Singapore = 1, United States and Taiwan = 0), and Condition × Taiwan and Condition × Singapore interactions. Given this coding, the simple effect of the condition reflects the effect in the United States, which was treated as the baseline country.

In the first analysis, we used the number of critical words recalled in the first recall task as the dependent measure. We found a simple effect of the recall condition, $\beta = -0.19$, $SE = .07$, 95% CI [−0.32, −0.06], $z = -2.86$, $p = .004$, indicating that U.S. participants recalled fewer critical words in the part-list cuing condition than in the free-recall condition. We found insignificant simple effects of the Taiwan dummy ($\beta = -0.08$, $SE = .06$, 95% CI [−0.20, 0.04], $z = -1.27$, $p = .205$), the Singapore dummy ($\beta = -0.02$, $SE = .06$, 95% CI [−0.14, 0.10], $z = -0.27$, $p = .790$), and the Condition × Taiwan interaction ($\beta = 0.03$, $SE = .09$, 95% CI [−0.14, 0.21], $z = 0.37$, $p = .715$). However, the Condition × Singapore interaction was significant, $\beta = 0.18$, $SE = .09$, 95% CI [0.007, 0.35], $z = 2.04$, $p = .041$.

To investigate this interaction effect, we ran separate negative binomial regressions by culture. The effect of condition was significant in the United States, $\beta = -0.19$, $SE = .07$, 95% CI [−0.33, −0.05], $z = -2.75$, $p = .006$, and Taiwan, $\beta = -0.16$, $SE = .06$, 95% CI [−0.28, −0.04], $z = -2.56$, $p = .010$; the negative sign of the coefficient in these two cultures indicates that the number of critical words recalled in the first recall task was significantly lower in the part-list cuing condition than that in the free-recall condition. However, there was no significant difference between conditions in the Singapore sample, $\beta = -0.01$, $SE = .05$, 95% CI [−0.11, 0.09], $z = -0.24$, $p = .808$.

In the second analysis, we used the number of critical words recalled in the second recall task (in which there were no cue words across all conditions) as the dependent measure. We found an insignificant simple effect of the recall condition ($\beta = -0.09$, $SE = .07$, 95% CI [−0.22, 0.04], $z = -1.36$, $p = .172$), an insignificant simple effect of the Taiwan dummy ($\beta = -0.03$, $SE = .06$, 95% CI [−0.15, 0.09], $z = -0.48$, $p = .634$), the Singapore dummy ($\beta = 0.007$, $SE = .06$, 95% CI [−0.11, 0.13], $z = 0.12$, $p = .904$), and the Condition × Taiwan interaction ($\beta = -0.09$, $SE = .09$, 95% CI [−0.26, 0.09], $z = -0.97$, $p = .331$). In addition, the Condition × Singapore interaction was insignificant, $\beta = 0.16$, $SE = .09$, 95% CI [−0.01, 0.33], $z = 1.80$, $p = .072$. The results indicate that the number of critical words recalled in the second recall task did not differ either by condition or culture. Thus, participants from the United States and Taiwan who were in the part-list cuing condition in the first recall task now overcame the recall impairment, thus exhibiting recovery from disruption.

One possible explanation for why the Singaporean participants did not exhibit the part-list cuing impairment is that they did not pay attention to the cue words in the first recall. If this was the case, then in the part-list cuing condition, Americans and Taiwanese should recall more cue words in the second recall task than Singaporeans. We tested this idea in our third analysis, using the number of cue words recalled in the second recall task as the dependent variable. We found a simple effect of recall condition, $\beta = 0.74$, $SE = .06$, 95% CI [0.62, 0.86], $z = 12.51$, $p < .001$, indicating that the U.S. participants recalled significantly more cue words in the part-list cuing condition than in the free recall condition. There were no significant simple effects of the Taiwan dummy ($\beta = -0.07$, $SE = .06$, 95% CI [−0.19, 0.05], $z = -1.20$, $p = .231$) or the Singapore dummy ($\beta = 0.06$, $SE = .06$, 95% CI [−0.05, 0.18], $z = 1.06$, $p = .290$). The Condition × Taiwan interaction ($\beta = 0.09$, $SE = .08$, 95% CI [−0.07. 0.24], $z = 1.08$, $p = .279$), and the Condition × Singapore interaction ($\beta = -0.01$, $SE = .08$, 95% CI [−0.16. 0.14], $z = -0.13$, $p = .894$) were also insignificant. This finding suggests that across all three cultures, participants in the part-list cuing condition paid a similar amount of attention to the part-list cues.

Discussion

Study 1 replicated the part-list cuing impairment in the United States and Taiwan ($g = .45$ and $g = .37$, respectively).[1] Thus, like Barber and Rajaram (2011), after whom our method was modeled, we also obtained medium effect sizes. These are consistent with the overarching body of literature as reported in a recent meta-analysis ($g = .55$; Pepe et al., 2023). Strikingly, Singaporean Chinese participants did not exhibit any part-list cuing impairment, $g = .03$. These findings suggest that the part-list cuing impairment varies by culture, but a basic East-West explanation is insufficient—although Taiwanese participants exhibited the effect, Singaporean participants did not. The findings are inconsistent with H1, H2a, and H2b, and thus alternative explanations are required to account for this difference.

One possible explanation for the difference observed between Taiwan and Singapore could be the language used in the experiment (i.e., Chinese vs. English). However, we could not conduct the study in Chinese in Singapore because previous studies have found that many Singaporean college students struggle with written Chinese due to their relative lack of practice

(Xie & Cavallaro, 2016). Although Singaporean Chinese learn Mandarin Chinese in school and frequently use Chinese during informal conversations and in domestic settings, Chinese is typically not used in formal settings—English is still the medium of instruction in grade school and college (Department of Statistics, 2015; C. L. P. Ng, 2014). Furthermore, the language used is unlikely to explain the Taiwan-Singapore difference because, in both countries, we used their primary language of education. Indeed, in a follow-up study, we sought to replicate Study 1 in Singapore while presenting all instructions and stimuli in simplified Chinese instead of English (unlike Taiwan, which uses traditional Chinese characters, Singapore uses simplified Chinese characters). However, all participants indicated that they did not understand a significant proportion of the study words, leading us to abort the study.

That said, it is important to note that the part-list cuing impairment is observed in locations where participants can be assumed to be bilingual or multilingual, such as Canada (e.g., English-French bilinguals; Mueller & Watkins, 1977), Germany (e.g., German-English bilinguals; Lehmer & Bäuml, 2018a), Sweden (e.g., Swedish-English bilinguals; Andersson et al., 2006), and now Taiwan (although the official language in Taiwan is Mandarin Chinese, many people are also fluent in Taiwanese [*Minnanyu*], Hakka, or indigenous languages; Lyu et al., 2004). Thus, a basic explanation of bilingual differences between the United States and Singaporean samples seems unlikely. Later, in the General Discussion section, we return to this possibility in more detail.

Study 2

Hypotheses 1, 2a, and 2b were all not supported by the findings of Study 1. Instead, we observed that the part-list cuing impairment appeared in both the American and Taiwanese samples but not in the Singaporean sample. Therefore, we conducted Study 2 to explore a potential explanation as to why the part-list cuing impairment was not observed in Singapore (i.e., due to the idiosyncrasies of the stimuli). Although the part-list cuing impairment was reliably observed in both Taiwan and the United States, we decided to focus only on Singapore and the United States in Study 2 to reduce its complexity while still comparing two distinct cultures, also considering that the Taiwanese sample would be less representative of the part-list cuing literature as a baseline comparison group than an American sample.

The Study 1 stimuli were selected based on U.S. word norms (Van Overschelde et al., 2006), but we recognize that the response frequency of the exemplars used could differ by culture. As shown by Bäuml et al. (2002), using lower-frequency exemplars from each category as part-list cues produces a larger impairment. One could argue that the lack of part-list cuing impairment among our Singaporean sample in Study 1 resulted from using stimuli based on U.S. word norms, as the associations between the items would likely be stronger for Americans than for Singaporeans. Importantly, our Taiwanese participants in Study 1 were statistically indistinguishable from Americans in their response patterns, which suggests that this explanation cannot fully explain the pattern of results in Study 1; however, we still aimed to rule out this possibility as an explanation of the Unites States-Singapore comparison with a stringent empirical test by altering the stimuli in Study 2.

To this end, we developed Singaporean word norms and selected stimuli based on this norming study. The newly developed stimuli based on Singaporean word norms were then used in a part-list cuing study conducted in Singapore and the United States. Thus, these normed stimuli were likely to reduce the part-list cuing impairment in the U.S. sample by weakening the associations between items but magnify the impairment in Singapore by increasing inter-item associations. We did not include a Taiwanese sample as a baseline, as it is unclear how the Singaporean-adapted stimuli would influence (either strengthen or diminish) associations between the words in Taiwan. By contrast, using a different set of normed

stimuli offered an opportunity to test the limits of the part-list cuing impairment in a canonical Western sample of participants and compare it to the Singaporean sample that showed an absence of this effect in Study 1.

If the reason for the absence of part-list cuing impairment in the Singaporean sample in Study 1 is because of a mismatch in the participants' culture and the stimuli's word norms, then we should expect a reversal in this study—the presence of part-list cuing impairment in the Singaporean sample but not in the U.S. sample. As noted earlier, a strong version of this possibility is unlikely because we observed a part-list cuing impairment for the Taiwanese participant sample in Study 1. However, if a match between participants' culture and the stimuli's word norms matters to some extent but is insufficient to explain the differences observed in Study 1, then we should see a weakened version of Study 1's finding, with the possibility of a part-list cuing impairment in the Singaporean sample (albeit weaker than that in the U.S. sample). If a match between participants' culture and the stimuli's word norms does not matter at all, we expect to see the same results as in Study 1.

Method

Participants. We recruited 190 participants per culture. A power analysis using the U.S. effect size Cohen's $d = .45$, $\alpha = .05$ (two-tailed) based on Study 1 yielded power = 78%. All 190 undergraduate students were recruited from Stony Brook University (66.32% female; mean age 19.09 years, $SD = 1.82$) and were born in the United States, and another 190 undergraduate students were recruited from Nanyang Technological University (43.92% female; mean age 21.25 years, $SD = 1.30$), all of whom were ethnic Chinese born in Singapore.

Procedure. The methods were identical to those in Study 1 except for two changes. First, we used Singaporean instead of U.S. word norms. The procedure we used to generate Singaporean word norms and the resulting word list are included in the Supplemental Materials. We created a new word list by matching each category's average response frequency with that of the word list used in Study 1 as closely as possible. Second, instead of using two different distractor tasks, we used only one—participants were asked to watch a video and make a tally on a sheet of paper whenever the actor in the video touched an object. The rest of the methods were identical to those used in Study 1 and, as before, matched between cultures.

Results

Descriptive statistics are reported in Table 2. As in Study 1, we ran negative binomial regressions. The independent variables were condition (control = 0, part-list = 1), culture (United States = 0, Singapore = 1), and a Culture × Condition interaction. Given this coding, the simple effect of the condition reflects the effect in the United States, which was treated as the baseline country. In the first analysis, we used the number of critical words recalled in the first recall as the dependent measure. We found a marginal simple effect of the recall condition, $\beta = -0.14$, $SE = .07$, 95% CI [−0.29, 0.002], $z = -1.93$, $p = .054$, indicating that the standard pattern—participants recall fewer critical words in the part-list cuing condition than in the free-recall condition—was directionally present yet mitigated and insignificant. We found neither a simple effect of culture ($\beta = -0.06$, $SE = .07$, 95% CI [−0.20, 0.09], $z = -0.76$, $p = .446$), nor a Culture × Condition interaction ($\beta = 0.005$, $SE = .10$, 95% CI [−0.20, 0.21], $z = 0.04$, $p = .966$). Nonetheless, given the *a priori* predictions based on the findings in Study 1, we conducted a parallel analysis to examine the effect of condition separately by culture to test our predictions and clarify the marginal simple effect observed. In the United States, we

Table 2. Words Recalled in Study 2.

	Part-list cued recall			Free recall		
Country	*N*	*M* (*SD*)	95% *CI*	*N*	*M* (*SD*)	95% *CI*
Critical words in Recall 1						
United States	95	11.54 (4.69)	[10.58, 12.49]	95	13.29 (6.40)	[11.99, 14.60]
Singapore	92	10.97 (6.01)	[9.72, 12.21]	98	12.58 (6.37)	[11.30, 13.86]
Critical words in Recall 2						
United States	95	12.62 (5.00)	[11.60, 13.64]	95	13.63 (6.88)	[12.23, 15.03]
Singapore	92	12.51 (5.76)	[11.32, 13.70]	98	12.56 (6.50)	[11.26, 13.86]
Cue words in Recall 2						
United States	95	21.72 (5.87)	[20.52, 22.91]	95	10.01 (5.15)	[8.96, 11.06]
Singapore	92	17.05 (6.88)	[15.63, 18.48]	98	8.63 (5.24)	[7.58, 9.68]

Note. The descriptive statistics for the number of words recalled in Study 2.

found a significant part-list cuing impairment, $\beta = -0.14$, $SE = .07$, 95% CI [−0.27, −0.01], $z = -2.12$, $p = .034$. This impairment was insignificant in Singapore, $\beta = -0.14$, $SE = .08$, 95% CI [−0.30, 0.02], $z = -1.70$, $p = .090$.

In the second analysis, we used the number of critical words recalled in the second recall task as the dependent measure. We found no main effect of the recall condition, $\beta = -0.08$, $SE = .07$, 95% CI [−0.21, 0.06], $z = -1.10$, $p = .273$, indicating that, like in Study 1, a rebounding from the impairment occurred. We also found neither a main effect of culture ($\beta = -0.08$, $SE = .07$, 95% CI [−0.22, 0.05], $z = -1.17$, $p = .241$), nor a Culture × Condition interaction ($\beta = 0.07$, $SE = .10$, 95% CI [−0.12, 0.27], $z = 0.73$, $p = .464$). Thus, recovery from disruption was observed for participants from both cultures.

In the third analysis, we used the number of cue words recalled in the second recall task as a manipulation check to ensure that participants paid attention to the part-list cues. We found a main effect of the recall condition, $\beta = 0.77$, $SE = .06$, 95% CI [0.65, 0.90], $z = 11.98$, $p < .001$, indicating that participants in the part-list cued condition exhibited re-exposure benefits from attending to the cues in the first recall task. We also found a main effect of culture, $\beta = -0.15$, $SE = .07$, 95% CI [–0.28, –0.01], $z = -2.13$, $p = .033$, suggesting that participants in the United States recalled significantly more cue words than those in Singapore. However, the Culture × Condition interaction was insignificant, $\beta = -0.09$, $SE = .09$, 95% CI [−0.28, 0.09], $z = -1.01$, $p = .314$. Thus, the findings indicate that both American and Singaporean participants paid similar attention to the cue words.

Discussion

In Study 2, our baseline American sample exhibited a significant but smaller part-list cuing impairment with Singapore word norms; the effect size dropped from $g = .45$ in Study 1 to $g = .31$ in Study 2. This drop in effect size aligns with our predictions that decreasing the associations between the items would decrease the magnitude of the impairment. In contrast, although the part-list cuing impairment for Singaporean participants is statistically insignificant in both Studies 1 and 2, the effect size in Study 2 ($g = .26$) is comparatively larger than the effect size in Study 1 ($g = .03$). This finding also aligns with the prediction that increasing associations between items would have an impact on the magnitude of the impairment. Notably, though, if the United States-Singapore cultural difference in Study 1 was entirely due to a match in the cultural source of the word norms and that of participants for the

Americans (and a mismatch for the Singaporeans), we would expect the Singaporeans in Study 2 to exhibit a part-list cuing impairment of a similar magnitude as that exhibited by the American participants in Study 1 and the overarching literature ($g = .55$; Pepe et al., 2023), where U.S. word norms were used ($g \sim .45$). We would also expect the American participants in Study 2 to exhibit an impairment of a similar magnitude as that exhibited by the Singaporeans in Study 1 ($g \sim .03$). However, this did not happen.

In sum, the pattern of effect sizes across both studies suggests that although the culture-norm match matters (part-list cuing impairment is larger when the cultural source of the stimuli and the participants match), so does the culture itself (Singaporeans show a smaller impairment than Americans even when there is a match). Although the Culture × Condition interaction was insignificant in this study, this insignificant interaction needs to be interpreted in terms of the *a priori* predictions. These predictions were derived from the hypothesis that the United States-Singapore difference in Study 1 can be explained by the fact that Study 1 used words that were based on U.S. norms. For our baseline (American participants), the shift from the word norms of one's own country to the word norms of a foreign country should weaken the part-list cuing impairment in Study 2 compared to Study 1, whereas for Singaporean participants, the shift from the word norms of a foreign country to those of one's own country should strengthen the part-list cuing impairment in Study 2 compared to Study 1. In the absence of cultural differences in the part-list cuing impairment, we would expect the pattern observed in Study 1 to reverse, such that Americans would no longer show the impairment effect, whereas Singaporeans would show a recall impairment. However, this did not happen. Instead, Americans still showed a significant impairment that was still relatively stronger than that in Singapore. The insignificant interaction in Study 2 is notable because an explanation exclusively based on a culture match of word norms would have predicted a significant interaction in the opposite direction—a stronger part-list cuing impairment in Singapore than in the United States. The current findings suggest that the cultural match of the word matters but is not enough to explain the United States-Singapore difference found in Study 1.

The culture match effect across Studies 1 and 2 also suggests that if we had run the study in Taiwan using Taiwanese word norms, the part-list cuing impairment is likely to be even stronger than it was in Study 1 (where Taiwanese participants were presented with U.S. word norms).

General Discussion

The current findings indicate that the part-list cuing impairment in recall, which has thus far been an established memory finding in WEIRD cultures (Henrich et al., 2010), also replicates in Taiwan, a relatively less multicultural and largely monolingual East Asian culture. It does not, however, replicate as readily in Singapore, a more multicultural and multilingual Southeast Asian culture. These findings highlight cultural variations in basic memory processes. Furthermore, the overarching theory for understanding cultural differences in cognition—analytic versus holistic cognition (Nisbett et al., 2001)—cannot readily explain our findings. Although both Taiwanese and Singaporean Chinese are assumed to be holistic processors, they exhibit different magnitudes of part-list cuing impairment. These findings caution against placing different Asian cultures into a single category (Lu et al., 2020).

In the introduction, we outlined two competing hypotheses for part-list cued recall performance across cultures. Our first hypothesis, that the part-list cuing impairment is a universal phenomenon, was not supported. Our second hypothesis, that we would observe differences between groups that are traditionally analytical (i.e., Americans) versus holistic (i.e., Singaporeans and Taiwanese) in processing styles but not between the two holistic samples, was also inconsistent with our findings; presumably analytic American and holistic Taiwanese participants showed a similar part-list cuing impairment, whereas presumably holistic Singaporeans did not.

These findings, arising from direct empirical comparisons across cultures, prompt us to consider alternative explanations for our findings. One such possibility is the intersectionality of multiculturalism and multilingualism. Multiculturalism is defined as the coexistence of different languages, traditions, religions, customs, and practices, with each being equally respected and valued (Colombo, 2015). Multilingualism, on the other hand, is generally defined as the use of multiple languages in everyday life (Cenoz, 2013).

Singapore is distinct from the United States and Taiwan in that most Singaporeans speak both English and the mother tongue associated with their ethnic group (e.g., Chinese in the case of our participants) in their everyday lives, often switching between languages in the middle of a conversation and sometimes even in the middle of a sentence (Kamwangamalu & Lee, 1991; Tay, 1989). Although many of our American participants, especially those from ethnic minority backgrounds, might also speak multiple languages, they presumably do not routinely use multiple languages in their everyday lives at college. Similarly, although our Taiwanese participants are likely fluent in English, they would only occasionally speak English in their everyday lives. Although research on the part-list cuing impairment has been primarily conducted using samples from largely monocultural and monolingual cultures (Kelley et al., 2021; Xing et al., 2021), many studies have also found the effect using samples from countries in which multiple languages are spoken, such as Turkey (Peynircioğlu & Gökşen-Erelçin, 1988), Canada (e.g., Mueller & Watkins, 1977), Germany (e.g., Lehmer & Bäuml, 2018b), and Sweden (e.g., Andersson et al., 2006). However, in these studies, it is not clear whether participants themselves routinely spoke in multiple languages in their everyday lives, unlike our Singaporean Chinese participants. Thus, Singaporeans' everyday bilingualism could perhaps play a role in explaining why their part-list cuing pattern diverges from that of the other two groups.

Although most Singaporeans are effectively bilingual in English and their respective mother tongues (C. L. P. Ng, 2014), they often use "Singlish" in daily conversations. Singlish, a creole language developed in Singapore based on English, includes many words and phrases that are derived from Malay (the language of the Malaysian peninsula), Hokkien and Teochew (southern Chinese dialects), and Tamil (a southern Indian language; Fong et al., 2002). Thus, many Singaporeans have some basic knowledge of the other languages spoken in the country, even if the language is not their mother tongue. Given their use of Singlish, many Singaporeans have some competency in using words from different languages in their everyday conversations, even with others of their own ethnic group.

In addition, Singapore is a unique case of the intersection of multiculturalism and multilingualism (Cavallaro & Chin, 2020). Singapore's majority population is ethnic Chinese, with significant ethnic Malay and Indian populations (Bokhorst-Heng, 2007; H. A. Chen et al., 2005). Although English is the language of education and business, Singapore's education system requires its citizens to learn their mother tongues (C. L. P. Ng, 2014). Due to Singapore's history, multiculturalism has been a founding principle of the constitution and is one of the country's core cultural values (K. Ng, 2017). Major holidays for each ethnic group, such as Chinese New Year (ethnic Chinese) and Buddha's birthday (Chinese Buddhists), Deepavali (Indian Hindus), Eid-ul-Fitr and Eid-ul-Adha (Malay and Indian Muslims), Good Friday and Christmas (Chinese and Indian Christians), are recognized as national holidays and typically celebrated by most of the population in some capacity, even by those who do not identify themselves as belonging to the ethnicity or religion celebrated by the holiday.

The cultures in our sample vary in their degree of multiculturalism. Taiwan's population is predominantly ethnic Chinese, and Mandarin Chinese is the official language there. Although Taiwan can be considered multicultural in some respects (e.g., with indigenous populations and subgroups speaking different dialects of Chinese), multiculturalism has only recently been emphasized in Taiwan's national policy (L. J. Wang, 2004); Taiwan is typically considered to have a single dominant culture by many researchers (Nisbett & Miyamoto, 2005; Wong et al.,

2021; Wu, 2006). Furthermore, even though most college students in our Taiwanese sample learned English in their formal education, Mandarin Chinese is still their dominant and most commonly used language (S.-C. Chen, 2010). Thus, our Taiwanese and Singaporean samples present an elegant comparison in that both are predominantly ethnic Chinese (a design element that we were diligent in controlling) but differ in their extent of multiculturalism and multilingualism.

The United States is undoubtedly a nation of cultural diversity. However, multiculturalism has been given varying levels of importance across different U.S. states and eras (Mitchell & Salsbury, 2000). Unlike in Singapore, multiculturalism has not been a key element of national policy nor taught universally in the U.S. education system so far. The American notion of being a "melting pot" expects other cultures to merge into mainstream American culture over time (Alba & Nee, 2003). In sum, our three samples differ in varying degrees of intersectionality between multiculturalism and multilingualism—our U.S. sample is multicultural but largely monolingual, our Taiwanese sample is somewhat multicultural but largely monolingual, whereas our Singaporean sample is largely multicultural and multilingual.

The research that we will discuss next primarily focuses on the effects of multiculturalism. However, it is important to acknowledge that it is often difficult to disentangle multiculturalism and multilingualism. In fact, research focusing on either multiculturalism or multilingualism often includes the other in their theorizing (Dewaele & Botes, 2020; Dewaele & Van Oudenhoven, 2009; Fürst & Grin, 2023). Hence, the following discussion about multiculturalism should be considered with multilingualism in mind.

Prior research suggests that multiculturalism increases people's cognitive complexity (Leung et al., 2008), which refers to the extent to which people represent information on multiple dimensions (Benet-Martínez et al., 2006). Although there is limited research directly linking cognitive complexity with memory processes, greater cognitive complexity could allow individuals to build a more elaborated cognitive structure of the items presented in a memory task, resulting in a more resilient memory network. One explanation of the part-list cuing impairment is that the impairment occurs because the organization of the studied words in the part-list cues differs from the organization of the studied words in participants' memory. However, if Singaporeans have a more complex memory network in which words are linked to each other in multiple ways, such a network could be more resistant to disruption from part-list cues. Furthermore, past research found that in a baseline condition, there was little difference in recall based on participants' cognitive complexity, but in an interference condition (in which an unrelated task intervened in between an experience and its recall), individuals with greater cognitive complexity recalled more total information (Neuliep & Hazleton, 1986). If this finding generalizes to the part-list cuing impairment and if Singaporeans have greater cognitive complexity, then the prediction would be that Singaporeans' memory would be more resistant to interference from part-list cues. Thus, if Singaporeans' multicultural experiences lead to greater cognitive complexity, then this factor could explain the smaller part-list cuing impairment observed with Singaporeans.

In addition, multiculturalism and multilingualism both lead to greater cognitive flexibility (Giovannoli et al., 2020; Ritter et al., 2012; Spiegler & Leyendecker, 2017). Cognitive flexibility refers to the ease of dissociating existing cognitive associations and creating new ones (Dajani & Uddin, 2015; Goclowska et al., 2013; Ritter et al., 2012). Past research has found that experiencing complex non-normative events (such as multicultural experiences) increases participants' cognitive flexibility in an unrelated task (Ritter et al., 2012). Specifically, in this study, the researchers asked participants to generate new ideas and then determined the number of categories that participants' responses belonged to; cognitive flexibility was operationalized as generating ideas under more categories. According to the authors' definition, high cognitive flexibility is defined by an ability to switch between categories (i.e., breaking away from current cognitive associations and forming new ones). If Singaporeans have greater cognitive flexibility, then even

if the part-list cues disrupt their categorical organization of the studied words, they can rely on other forms of associations to recall the relevant words.

In multicultural and multilingual societies, where people constantly negotiate different customs and languages, people may by default use a more flexible processing style or adopt a broader scope of attention to juggle various pieces of information or concepts. One explanation for the part-list cuing impairment is that the cues disrupt the participants' recall organization for studied information (i.e., retrieval disruption; Basden & Basden, 1995). Singaporeans may be better (or faster) at switching to an alternative retrieval strategy when the part-list cues disrupt their current strategy, culminating in reduced impairment. These ideas are consistent with the view that balancing distinct, multiple cultures as well as languages is associated with flexible cognitive structures and processes (Leung et al., 2008; Spiegler & Leyendecker, 2017) and an increased attention scope (Tadmor & Tetlock, 2006), motivating future cross-cultural research to test this possibility.

In summary, we report that it is possible to observe both similarities and differences across cultures for robust memory phenomena. We document that the magnitude of memory disruption can be sensitive to varying degrees of multilingualism and multiculturalism in socio-cultural contexts. We also show that direct, yoked comparisons are particularly crucial for enriching scientific insights into the influence of culture on cognition and memory. Finally, our findings support the recommendations that a test of the universality of memory functions needs to be built by mainstreaming culture in the research design of memory and, more generally, cognition studies (Atran et al., 2005; Gutchess & Rajaram, 2023; Nisbett et al., 2001; Q. Wang, 2016).

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ORCID iDs

Tsung-Ren Huang https://orcid.org/0000-0003-4396-7943
Krishna Savani https://orcid.org/0000-0002-6934-1917

Supplemental Material

Supplemental material for this article is available online.

Note

1. We report Hedge's *g* rather than Cohen's *d* in the discussion so that our effect sizes can be compared to the overall effect size found in the meta-analysis of Pepe et al. (2023), which reports Hedges' *g*.

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