CULTURAL DISPLAY RULES DRIVE EYE GAZE DURING THINKING

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The authors measured the eye gaze displays of Canadian, Trinidadian, and Japanese participants as they answered questions for which they either knew, or had to derive, the answers. When they knew the answers, Trinidadians maintained the most eye contact, whereas Japanese maintained the least. When thinking about the answers to questions, Canadians and Trinidadians looked up, whereas Japanese looked down. Thus, for humans, gaze displays while thinking are at least in part culturally determined.

Keywords: eye gaze; communication; cross-cultural; gaze display; thinking

Eye gaze displays play an important role in social interaction. People use others' eye movements to regulate conversation (e.g., turn-taking), to make character judgments (e.g., honesty, shyness), and to gain insight into their internal mental processes (e.g., thinking). Extensive research has established that individuals engaged in thinking tend to avert eye gaze. To date, researchers generally agree that eye gaze aversion during thinking is triggered by endogenous brain activities.

The present study examined an alternative hypothesis that culture may also play a role in eye gaze display during thinking. This hypothesis is derived from the existing cross-cultural literature on eye gaze display. Societies have various eye-related norms regarding where and for how long one should look at a person during social interaction (Knapp & Hall, 2002). Indeed, researchers have found cultural variations in the interpretation of eye contact and averted gaze among individuals from different cultures. For example, eye contact is judged positively among North American individuals of European ancestry, whereas it is negatively judged among indigenous individuals, such as the Navaho Indians (e.g., Argyle & Cook, 1976; Bull & Gibson-Robinson, 1981; Collett, 1971; Hornik, 1987). European–North Americans perceive a person who looks up to be thinking and a person who looks down to be lacking in knowledge or confidence, or even to be deceitful. For

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Navaho Indians, Japanese, and Ethiopians, however, looking down is a sign of respect (Argyle & Cook, 1976; Collett, 1971). These differences in cultural convention may lead to different eye gaze displays during thinking. However, no evidence exists to support this suggestion. All existing studies on eye movements during thinking have involved participants of European cultural origins, leaving the role of culture entirely unexplored.

The present study aimed to bridge this gap in the literature. Canadian, Trinidadian, and Japanese adults were chosen as participants because the existing cross-cultural literature suggests differences in cultural conventions governing gaze display among these cultural groups (e.g., Argyle & Cook, 1976; Watson, 1970). We observed the duration of eye contact and the direction of gaze aversion when participants answered two types of questions, ones for which they knew the answers (the "know" condition or memory retrieval task) and ones for which they had to derive the answers (the "think" condition or the problem-solving task).

METHOD

Participants. Ten Canadian adults (5 females; mean age = 20.2 years, *SD* = 0.7), 10 Trinidadian adults (5 females; mean age = 21.2 years, *SD* = 0.8), and 10 Japanese adults (5 females; mean age = 20.7 years, *SD* = 0.6) participated (all right-handed). The Canadian participants were of European ancestry and had lived their entire lives in Canada. Japanese participants were of Japanese ancestry and had lived their entire lives in Japan. All materials were translated from English to Japanese for use with Japanese participants. Trinidadian participants were of Indian ancestry and had lived their entire lives in Trinidad. Prior to the experiment, each participant signed a consent form indicating his or her informed consent to participate in this study, and participants were fully debriefed at the end of the experiment.

Materials and procedures. Participants answered each of 20 questions placed on separate cue cards. Ten were "think" questions (4 verbal, 3 spatial, and 3 mathematical) that requiring thinking to answer (e.g., "If a car is traveling at 90 km/hour, how far will it travel in 1.5 hours?"). Ten were "know" or memory retrieval questions (e.g., "What is the color of the sky?"). Participants sat facing the interviewer across a table while a video camera recorded their faces. The video camera was visible to participants. Prior to each 20-minute test session, the cue cards were shuffled to randomize the order and the interviewer picked a card, looked at the question, and then maintained eye contact with the participant while asking the question.

Canadian participants were interviewed by a White Canadian female of European ancestry who was a native English speaker. Trinidadian participants were interviewed by a female Trinidadian Canadian. A native female Japanese speaker tested the Japanese participants. All interviewers were trained on the procedure to ensure that they conducted the test sessions in the same manner.

Scoring. Participant eye position was coded for each frame (1/30th second) for the period that began at the end of the interviewer's question and ended at the beginning of the participant's answer. For each frame, the participant eye position was recorded as "eye contact" if the participant's gaze was directed toward the eyes of the experimenter. Participant averted eye position was coded as "up" if it fell between 5° and 175° and as "down" if it fell between 185° and 355° of the horizontal median. Participant gaze was

recorded as "right" if it fell between 175° and 185° and as "left" if it fell between 355° and 5°. Interrater agreement, assessed for each frame of 18 records ($N = 6$ per country, randomly chosen; 93,164 frames in total), was 98%.

RESULTS

Participants varied in their latency to answer different questions within each question type. They also differed in their latency to answer the Know and Think questions (Know = 2.6 seconds, Think = 4.0 seconds). To control for latency variability within and between question types, the durations of eye contact and averted eye gaze were divided by the latency to answer (the period from the end of the question to the beginning of the participant's answer). This resulted in two scores for each question: a percentage duration score for eye contact and that for averted eye gaze. The eye contact percentage duration scores for all the questions within each question type were averaged to derive a Mean Eye Contact Percentage Duration Score for the Know and Think questions, respectively, for each participant. The same was done for averted percentage duration scores to derive Mean Averted Gaze Percentage Duration Scores. These scores indicated the average proportion of time each participant spent maintaining eye contact or averting gaze. For each participant, when the Percentage Duration Scores for Eye Contact and Averted Gaze for each question type were added together, they equaled 100%.

Each participant's Mean Averted Gaze Percentage Duration Score for each question type was further divided into four directions: up, down, right, and left. Because we were interested in the proportion of the total averted gaze duration that each participant spent in any particular direction, the duration of each of these four directions was divided by the Mean Averted Gaze Percentage Duration Score, resulting in Up, Down, Right, and Left Duration Scores, respectively. When added together, these four scores also equaled 100% for each participant.

Preliminary analyses revealed no significant effects of type of "Think" question (verbal, spatial, or math) or gender. Thus, the data for these factors were collapsed in the following analyses.

Eye contact. The means and standard deviations of the Eye Contact Duration Scores for the Think and Know questions are shown in Table 1. A two-way, mixed measures, question type (2: Know questions, Think questions) by country (3: Canada, Trinidad, Japan) ANOVA conducted on Eye Contact Duration Scores revealed a significant main effect of question type (Know vs. Think), $F(1, 27) = 59.61$, $p < .001$. As shown in Table 1, eye contact was significantly higher for the Know questions ($M = 69\%$, $SD = 21\%$) than for the Think questions ($M = 42\%$, $SD = 20\%$). Paired-samples t tests revealed significant condition effects for each country: Canada, $t(9) = 2.47$, $p < .05$; Trinidad, $t(9) = 11.27$, $p < .001$; Japan, $t(9) = 2.70$, $p < .05$. Also, there was a significant interaction between question type and country, $F(2, 27) = 7.17$, $p < .005$. Post hoc analyses showed that Trinidadian participants maintained significantly more eye contact than Canadian or Japanese participants did when answering Know questions, but no significant differences in eye contact durations were found when participants answered Think questions.

Averted eye directions. The means and standard deviations of the Up and Down Duration Scores for the Think and Know questions are shown in Table 1. A three-way,

TABLE 1
Mean Percentage Durations (and Standard Deviations) of Eye Contact, and Averted Gaze Up and Down for Know and Think Questions Answered by Canadian, Trinidadian, and Japanese Participants

	Know Questions						*Think Questions*					
	Eye Contact	SD	*Averted Gaze Up*	SD	*Averted Gaze Down*	SD	*Eye Contact*	SD	*Averted Gaze Up*	SD	*Averted Gaze Down*	SD
Canada	64	19	35	27	32	24	47	23	80	19	14	14
Trinidad	88	22	36	44	31	31	43	18	82	15	13	12
Japan	54	16	23	15	56	22	36	22	15	16	75	16

mixed measures, question type (2) by eye direction (2) by country (3) ANOVA revealed a significant main effect of question type, $F(1, 27) = 15.43$, $p < .005$; significant interactions between eye direction and country, $F(2, 27) = 33.46$, $p < .001$, and question type and eye direction, $F(1, 27) = 8.42$, $p < .01$; and a significant three-way interaction between question type, eye direction, and country, $F(2, 27) = 6.87$, $p < .005$.

Post hoc analyses revealed that this significant three-way interaction was due to the following reasons. First, in the Know condition, Canadian and Trinidadian participants did not display a significant bias in their direction of averted gaze, but Japanese participants showed a strong downward bias ($M = 56\%$, $SD = 22\%$ for downward gaze vs. $M = 23\%$, $SD = 15\%$ for upward gaze; $t(9) = 3.51$, $p < .01$). Second, both Canadian and Trinidadian participants displayed significantly more upward gaze in the Think condition than the Know condition, 81% ($SD = 17\%$) for Think questions vs. 35% ($SD = 36\%$) for Know questions, on average; Canada: $t(9) = 3.48$, $p < .01$; Trinidad: $t(9) = 2.88$, $p < .05$, but no significant difference in their downward gaze between these two conditions. Japanese participants, however, showed exactly the opposite effect. They displayed significantly more downward gaze in the Think condition ($M = 75\%$, $SD = 16\%$) than the Know condition ($M = 56\%$, $SD = 22\%$; $t(9) = 3.35$, $p < .01$) but showed no significant difference in their upward gaze between these two conditions. Third, in the Think condition, both Canadian and Trinidadian participants displayed significantly more upward gaze than downward gaze, 81% ($SD = 17\%$) for gaze upward versus 14% ($SD = 13\%$) for gaze downward, on average; Canada: $t(9) = 6.33$, $p < .001$; Trinidad: $t(9) = 8.35$, $p < .001$. In contrast, Japanese participants displayed significantly more downward than upward gaze, 75% ($SD = 16\%$) for gaze downward versus 15% ($SD = 16\%$) for gaze upward; $t(9) = 6.23$, $p < .001$.

With respect to averted gaze in the right and left directions, a three-way, mixed measures, question type (2) by eye direction (2) by country (3) ANOVA conducted on the Right and Left Duration Scores revealed a significant main effect of question type, $F(1, 27) = 8.65$, $p < .01$. The significant main effect was due to the fact that participants had longer durations of averted gaze in the horizontal right or left plane when answering Know ($M = 11\%$, $SD = 16\%$) than the Think ($M = 4\%$, $SD = 5\%$) questions. No other effects were significant.

DISCUSSION

We examined the cross-cultural difference in eye gaze displays when people answered questions for which they either knew the answer or had to derive the answer (i.e., thinking).

When they knew the answers to the questions, Trinidadians and Canadians maintained eye contact most of the time (88% and 64%, respectively). When Trinidadians and Canadians did avert their gaze, they showed no directional bias. This gaze pattern is consistent with the Trinidadian and Canadian social conventions that maintaining eye contact signals high levels of knowledge and confidence. In contrast, the Japanese maintained eye contact for only 54% of the time and tended to look down when they averted their gaze. This gaze pattern is consistent with Japanese social conventions that downward eye gaze signals respect and that excessive eye contact is impolite.

When answering the Think questions, participants maintained eye contact for less than 50% of the time, and no cultural differences were found in terms of eye contact. In other words, participants in all three cultures averted their gaze when they had to think about the answers to the questions. This result concurs with existing research showing that individuals avert their gaze when thinking. Theorists have suggested that this gaze aversion is driven by endogenous brain activities associated with thinking of cognitive strategies to avoid distraction (e.g., Dunn, Bartscher, Turaniczo, & Gram, 1989; Glenberg, Schroeder, & Robertson, 1998; Gur, 1975; Kinsbourne, 1972). However, we have identified a cross-cultural difference in the direction in which participants avert their gaze during thinking. Canadians and Trinidadians tended to look up, whereas Japanese tended to look down. Thus, although gaze aversion may be a universal behavior during thinking, the participants' averted gaze direction may be governed by cultural conventions. Because looking down is perceived to be polite and respectful in Japan, the Japanese must look down when they think about the answer to a question. By contrast, in Trinidad and Canada looking down has negative connotations (i.e., suggesting a lack of knowledge or confidence). So people in these cultures look up when thinking. Perhaps, this may account for the origin of the belief in these two countries that looking upward signals thinking.

The present findings have important methodological implications for understanding the relationship between eye gaze displays and thinking. Most researchers (e.g., Dunn et al., 1989; Gur, 1975; Kinsbourne, 1972) have only measured horizontal gaze shifts. Our study is one of only a few (e.g., Previc & Murphy, 1997) to examine vertical and horizontal gaze shifts during thinking. Given our results, data on vertical gaze shifts should be collected when eye gaze patterns during thinking are studied in the future.

Our findings also have important theoretical implications. Historically, researchers have long taken into consideration the important role of sociocultural factors in eye gaze display during communication (e.g., Argyle & Cook, 1976; Watson, 1970). One anomaly is the research on the relationship between eye gaze display and thinking, which has seldom considered sociocultural factors (e.g., Kinsbourne, 1972; Previc & Murphy, 1997). Instead, major theories have focused on endogenous brain activities and arousal. Our results resolve this anomaly in the literature and point out that theorization about eye gaze display during thinking must also take into consideration the potential role of social factors such as culture. Our findings suggest that sociocultural factors play an important role in the display of eye gaze in all aspects of human activities, including thinking, as long as the activities involve multiple individuals.

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