'Air writing' and second language learners' knowledge of Japanese kanji

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Abstract

Most discussion of the acquisition of Sino-Japanese characters (*kanji*) conceptualizes it as a three-sided cognitive task of linking visual forms to units of sound and units of meaning. However, native speakers of Japanese frequently rely on kinesthetic stimulation to build their knowledge of *kanji,* and to cue recall of *kanji*, by making spontaneous, abstract, gestures with their fingers and hands known as *kūsho* (‘air writing’, 空書) while learning or recall is underway. In this sense, one might conceive of *kanji* as comprising bundles of units of form, sound, meaning—and of movement. This article explores the extent to which adult second language (L2) learners of Japanese exploit this fourth, kinesthetic, facet of *kanji* expertise, building on psycholinguistic research into native speakers’ use of *kūsho*. An empirical study revealed that 44 of 44 adult L2 learners spontaneously employed *kūsho* at least once in a variety of *kanji* learning and recall tasks. Moreover, the data suggest that the more difficulty learners encountered in recalling *kanji*, the more *kūsho* they employed. The article concludes with some speculations about the relevance of these findings to the teaching and learning of Japanese as an L2.

Introduction

Acquiring literacy in Japanese necessarily entails familiarity with Sino-Japanese characters, or *kanji*. Much has been written about the history of *kanji* (Habein 1984; Seeley 1991); about the role of *kanji* in Japanese culture (Twine 1991; Gottlieb 2005); about the psycholinguistic status of *kanji* (Kess and Miyamoto 1999); and about how best to acquire *kanji* (e.g. Heisig 2007–8). Gottlieb depicts *kanji* as a ‘privileged signifier of Japanese culture and an ideologically productive site of discourse within that culture’ (2000:197). Second-language learners of Japanese readily grasp the cultural and linguistic salience of *kanji*, often measuring their success with the language in terms of the numbers of specific *kanji* with which they are familiar.

Materials that introduce *kanji* to L2 learners conventionally stress the association of visually-perceptible shapes of characters to specific sounds and to meanings, so that learners accept that *kanji* comprise tripartite bundles of semantic, phonetic, and visual-configurational features (Paradis, Hagiwara, and Hildebrandt 1985:192–3; Richmond, 2005:48). The learner’s task is to memorize and be able to quickly and accurately access a mental network of these bundles of meanings, sounds, and shapes. This is a complex and demanding cognitive skill. Since the 1980s a small stream of psycholinguistic research by Japanese scholars has explored an informal practice that apparently serves as a resource to native speakers in meeting the demands of a writing system where *kanji* are central. This resource is *kūsho* (空書, translated as ‘air writing’), a common, apparently kinesthetically-based, practice that is rarely the focus of explicit attention, but which is recognizable to

anyone literate in Japanese. This article reports a study of whether L2 learners of Japanese employ *kūsho*, and if so, what role it plays in their orthographic repertoire.

Kūsho

The term *'kūsho'* is unfamiliar to most speakers of Japanese, but when the phenomenon itself is demonstrated, both native and non-native speakers universally recognize it: typically, a writer either trying to recall a specific *kanji*, or to acquire a new *kanji,* makes small, precise, gestures tracing out parts of the target *kanji* with a bare fingertip of his or her dominant hand on a tabletop or on the open palm of the non-dominant hand, often with the heel of the hand braced against a surface and the eyes averted, rolled up to the ceiling, or even closed. Writers may employ *kūsho* only fleetingly while writing; or, they may sustain it uninterruptedly while inspecting *kanji* that they are trying to learn; or, they may resort to *kūsho* episodically when faced with intermittent challenges in *kanji* recall. Sometimes writers produce *kūsho* in the air, unsupported by any surface, imagined or real. They may produce *kūsho* on the top of their kneecaps, or the side of their legs, out of sight under a tabletop. Sometimes writers rest their eyes on the hand producing *kūsho*, but visual support for the practice seems inessential, and is often lacking, as if the effects of *kūsho* are more strongly registered in the absence of feedback through the eyes.

Kūsho is also employed in face-to-face conversation, when speakers want to call meta-linguistic attention to their words, or when there is a threat of miscommunication: facing his or her conversational partner, a speaker may elucidate an ambiguous meaning by spontaneously 'writing in the air' in the space between them, often near an edge of the two

interlocutors' shared visual field. These are all common, routine, practices. Public transportation in Japan provides daily opportunities to observe *kūsho*—by schoolchildren preparing for class on the way to school; by commuters engaged in conversation over the din of public address announcements and passing trains; and occasionally by solitary people who may be observed absent-mindedly tracing *kanji* on an open palm or on an adjacent empty seat, apparently 'talking' to themselves through the written language, with kinesthetic support.[1]

The ubiquity of *kūsho* and its perceived utility lead native speakers to take it for granted as an unremarkable fact about writing and oral communication. Many Japanese I have spoken with are amused or mystified when their attention is drawn to *kūsho*, as if its existence and role required no explanation. Some dismiss it as simply a residue of the traditional elementary school practice of learning the shapes of *kanji* through repetitive pen-and-paper copying of printed models.[2] By these lights, *kūsho* is a streamlined version of a long-established material habit, in which, for convenience, stymied adult writers (or speakers) substitute a finger for a pen and air for paper. However, that account of *kūsho* falls short because, unlike repetitive copying, *kūsho* is essentially kinesthetic rather than visual. The act of repetitive copying of *kanji* on paper certainly also has kinesthetic content. But the goal of repetitive copying is to produce a visually perceptible reproduction that can be checked against a model, so that the learner's eyes are fixed on the emerging reproduction as he or she constructs it stroke-by-stroke with a pen or brush. Conversely, *kūsho* certainly has visual content. But learners' general habit of directing their gaze away from the *kūsho*-producing hand, or even closing their eyes, suppresses visual feedback. This

suggests that the goal of *kūsho* is to produce kinesthetic, not visual, stimulation, inverting the properties of pen-and-paper copying practice.[3]

Kūsho seems, therefore, to be a feature of the traditional orthography of Japanese that attracts little self-conscious attention from native speakers. Likewise, scholarship on the Japanese writing system (e.g. Miller 1986:5–45; Erbaugh 2002; Unger 2004) or its history (e.g. Habein 1984; Seeley 1991; Gottlieb 2000) does not address *kūsho*. Classic and contemporary textbooks and reference manuals directed at English-speaking L2 learners of *kanji* (*inter alia*, Chaplin and Martin 1969; Habein and Mathias 1991; Bowring and Laurie 1992; Ashworth and Hitosugi 1993; Heisig 2007–8; Sakade 2003), as well as a review of pedagogical texts (Richmond 2005) turned up no acknowledgement of *kūsho*. Literature addressed to teachers of Japanese (e.g., Shimizu 1997; Koda 2001; Haththotuwa Gamage 2003; Ezaki 2010; Mori 2012) does not identify *kūsho* as relevant to instruction in L2 writing. L2 learners' reflections on their own acquisition of the language does not advert to *kūsho* as a resource in the mastery of *kanji* (Okita 1997; Leung 2002). Farther afield, the emerging subfield within linguistics and cognitive science that studies gesture as a component of human communication (e.g. McNeill 2000; Steeck 2009) has not, to my knowledge, analyzed or even noticed *kūsho*.[4]

Moreover, *kūsho* is not a major theme in Japanese psycholinguistics. It is recognized in passing, if at all, by Chen (1997), Kess and Miyamoto (1999), Leong and Tamaoka (1998), Nakayama (2001), Nakayama, Mazuka, and Shirai (2006), and Paradis, Hagiwara, and Hildebrandt (1985). *Kūsho* has, however, captured the attention of a few specialists. A small, somewhat disjoint, body of exploratory research confirms that *kūsho* is widespread among native speakers of Japanese, and seems to help them access their competence. A

pioneering study by Sasaki (1984) found that *kūsho* appears in children as young as 7 years, becoming well established by age 11 or 12. Murakami (1991) compared the incidence of *kūsho* among adults and school-aged children, finding that when they were asked to identify *kanji* that contained a specific grapheme, older participants used more *kūsho* than younger ones. Sasaki and Watanabe (1984) and Sumiyoshi (1996) independently reported that both Japanese- and Chinese-speaking adults employ *kūsho* when performing various recall and manipulation tasks with words in L2 English. Working with only native speakers of Japanese, Endo (1988) likewise found that participants who used *kūsho* spontaneously in spelling English words performed more accurately when they spelled those words aloud while tracing the shapes of the target words with a bare fingertip on a blank sheet of paper. Sasaki and Watanabe (1983) conducted a study in which adult speakers of Japanese assembled components of *kanji* into recognizable characters. They discovered that participants' performance was reduced when they were prevented from using *kūsho*. Similarly, Haga (2009) showed that suppression of *kūsho* in a *kanji* stroke-counting task lowered native speakers' performance, at least when the target stimuli were presented for only 1000ms.

In short, despite the low profile of *kūsho* as a component of the Japanese language, there is preliminary empirical evidence that: (a) the frequency of use of *kūsho* increases from childhood; (b) native speakers of Japanese (and Chinese) spontaneously employ *kūsho* in a variety of contexts; (c) employment of *kūsho* improves performance on certain language tasks, including tasks that involve spelling words in L2 English; and (d) when native speakers of Japanese are prevented from using *kūsho* in tasks where they recall *kanji,* or manipulate parts of *kanji*, their performance is depressed relative to their

performance on the same tasks when *kūsho* is uninhibited. To date, no work has integrated these observations into a comprehensive proposal about the cognitive function of *kūsho*. The most that can be said at present is that it has some role in facilitating recall of *kanji* and in assisting writers in the performance of tasks that involve identifying and manipulating the shapes of *kanji* and their component parts.

There are many aspects of the phenomenon of *kūsho* that existing research has not yet explored. One is the role of *kūsho* in learning (rather than recalling) *kanji*, although scholars (e.g. Sasaki 1987:145) sometimes presuppose that *kūsho* derives from children's experience of repetitive copying of *kanji*. Another facet is whether—as is assumed but not proven—*kūsho* is unique to '*kanji* cultural area[s]' (Sasaki 1987:135), which include Japanese and Chinese speech communities, and possibly Korean speech communities insofar as there is residual use of Chinese characters. A third unexplored issue is the question of whether L2 learners of Japanese acquire *kūsho.*

Do L2 learners use *kūsho*?

This study is a preliminary investigation of what role (if any) *kūsho* plays in adult L2 acquisition and retrieval of Japanese *kanji*. I address several related questions:

1. The most basic question is whether adult L2 learners of Japanese do, in fact, employ *kūsho,* since this has not been demonstrated in earlier research.

Three additional research questions anticipate a positive answer to the first.

2. Do L2 learners of Japanese employ *kūsho* at different rates in the performance of different tasks? That is, if L2 learners do employ *kūsho*, do they do so while learning novel *kanji*, recalling already-studied *kanji*, or both? Are certain tasks more likely to elicit *kūsho*?

3. Are there perceptible individual differences among L2 learners in the use or non-use of *kūsho*? If so, what learner-specific variables correlate with those differences?

4. Finally, what role can *kūsho* be inferred to play in L2 learners' orthographic practices? For example, does the rate of employment of *kūsho* correlate with the interval required for recall, or with the accuracy of recall? Does preventing learners from employing *kūsho* inhibit learning or recall?

Method

Overview

This study comprises two parts. In Part 1, learners first identified *kanji* with which they were unfamiliar from a fixed array. In two subsequent tasks within Part 1, they then memorized *kanji* they had identified as novel, under two different learning conditions: one designed to allow use of *kūsho*, the other to inhibit its use. After each learning phase, learners reproduced on paper the *kanji* they had memorized. In Part 2, I asked participants to write *kanji* they were already familiar with in response to specific prompts. This research design allowed me to observe learners' use or non-use of *kūsho* in three contexts: as they learned *kanji*; as they retrieved recently-learned *kanji*; and as they retrieved *kanji* from long-term memory.

Both Parts 1 and 2 were videotaped, focusing on participants' hands, arms, heads, and the orientation of their gaze relative to their hands. Quantitative analysis of the resulting data assessed participants' use and non-use of *kūsho*, and tested for correlations between the use of *kūsho* and the following: demographic variables; participants' accuracy

of retrieval of *kanji* under different conditions; and participants' speed of response to the experimental tasks.

Participants

Forty-four adult learners of Japanese who were living in Japan participated. Each was paid ¥1000 (approximately US$12.00). The minimum criteria for participation were: (a) age 18 or older; (b) completion of at least 1 year of study of Japanese as an L2; (c) at least 2 months residence in Japan. The study was restricted to people living in Japan because they presumably have had abundant opportunities to observe *kūsho* as it is spontaneously used by native speakers, whereas classroom learners abroad may or may not have had those opportunities. The minimum of 2 months residence was set as an estimate of what counted as more than fleeting exposure to native speakers' orthographic practices. Regarding the participants' proficiency in Japanese, no investigation into their skills was conducted beyond ascertaining that they met the criterion of one year of prior study. On the basis of their self-reported length of study of Japanese (from 1 to 17 years), they would likely be classifiable as intermediate to advanced learners. I do not partition learners by proficiency level, nor do I try to determine the development of *kūsho* over the course of acquisition of Japanese.

Participants were of diverse language backgrounds, roughly divided among L1 speakers of the '*kanji* culture' languages Chinese and Korean; of English; and of 9 other languages. Their length of study of Japanese and of residence in Japan varied. Twenty-eight participants were male, 16 female. All were affiliated with universities near or in Tokyo or Osaka, 36 as undergraduate or graduate students and 8 as teachers. Tables 1 and 2 provide additional details about the participants' backgrounds. I purposely sought a heterogeneous

participant pool, casting a wide net for evidence of whether L2 learners—of whatever L1s or levels of L2 proficiency—do or do not employ *kūsho,* since that preliminary question needs to be addressed before more finely articulated questions can be posed.

[Insert Tables 1 and 2 about here]

I also gathered data from two other groups. I met informally with 5 native speakers of Japanese, comprising 4 college students enrolled in a study-abroad semester at a university in the United States, and one teacher of Japanese with lengthy residence in America. The native speakers' ages and educational backgrounds therefore resembled those of the L2 learners. All were female. My purpose was to pilot-test techniques for eliciting *kūsho*, and to engage native speakers in reflection on their practice of *kūsho*. I do not directly report these findings here, but used what I learned to design the study of L2 leaners. In addition, I relied on these native speakers' intuitions to help identify what counts as *kanji* with difficult versus easy shapes.

Second, I tested 6 adult native speakers of English, who were intermediate to advanced L2 learners (2 each of Spanish, French, and Russian), as estimated from their length of exposure to the L2. For each of these three subgroups, I translated and adapted the two-part research protocol into Spanish, French, or Russian. The goal was to observe whether a sample of learners of Spanish, French, or Russian employed any practice resembling *kūsho* when learning or recalling words in a 'non-*kanji* culture' L2. Appendix B provides additional information about collection of data from the comparison group.

<u>Materials</u>

Consent form. A consent form meeting the requirements of my local Institutional Review Board was distributed, explained, and signed by participants in advance of collecting the data.

Data sheet. I recorded on a separate data sheet each participant's oral responses to questions posed during the two interview phases of the procedure (see below). I also noted observations of the participants' gestures and postures as a supplement to the video recordings.

Response booklet. Participants recorded their responses in a booklet comprised of an 8.5 by 11-inch sheet divided in quarters sideways to form four 8.5-inch-long vertical columns, then folded accordion-style to create four 'pages' on each side. I turned the pages of the booklet after each trial so as to always present participants with a clean space on which to write. An arabic number at the top of each page identified the trial, followed by a column of three 1.75-by-2-inch boxes, where participants wrote the three *kanji* elicited in that trial, one to a box. To encourage participants to produce large, legible, *kanji*, I provided a thick-nibbed ballpoint pen.

Kanji stimuli for Part 1. The 22 *kanji* stimuli used in Part 1 were photocopied from Nelson and Haig (1997), enlarged to 2.5-by-2.5 inches, and presented on individual index cards. They comprised 7 fillers and 15 test *kanji*. The fillers were 7 relatively common *kanji*, presumably familiar to the participants: 6 are among the *kyōiku kanji*, with 1 additional filler among the immediately larger superset of *jōyō kanji*. The purpose of including fillers was to ensure that learners could identify at least some *kanji,* boosting their sense of competence. However, filler *kanji* were actually excluded from the test procedure.

The 15 test *kanji,* the focus of interest, were chosen for their likely unfamiliarity to intermediate and advanced L2 learners. I selected them out of a larger pool retrieved from Nelson and Haig (1997) using three criteria: *kanji* that are (a) not included in the *jōyō kanji* list; (b) visually complex (i.e., assembled out of 17 to 26 strokes, mean 21; cf. for the filler *kanji*, 7 to 20 strokes, mean 12); and (c) not readily and exhaustively decomposable into common, easily recognizable, components.[5] In the design phase of the study, I presented about 35 *kanji* meeting these criteria to five native speakers of Japanese, asking them to identify those they had not previously encountered, and deemed difficult in shape. Out of a pool of 35 characters, I extracted only those that all five native speakers identified as both unfamiliar and difficult, arriving this way at the 15 test *kanji*. Appendix C lists the 7 filler and 15 test *kanji*.

iPad 2 tablet computer. A research assistant recorded audio and video footage of the test procedure on an iPad 2, creating 44 video files from 15:40 to 47:38 minutes in length, averaging around 29 minutes.

Procedure

Parts 1 and 2 each comprised multiple tasks. They were carried out in that order, in a single individual session with each participant. The language used during instruction and explanation was English for most participants, with frequent code-switching into Japanese. Japanese was used with the minority of L2 learners or native speakers who judged their proficiency in English inadequate.

Part 1. Part 1 investigated the use of *kūsho* during learning and recall of newly-learned *kanji*. After participants signed the consent form and orally re-affirmed their willingness to be video taped (after which point video taping commenced), I presented

them with the 22 randomized index cards inscribed with *kanji* and the instruction to sort them into two piles: ‘*kanji* that you already know, might know, or used to know’ versus ‘*kanji* that you do not recognize and have no knowledge about’. Most participants completed the sorting task within 1 or 2 minutes, usually separating the 7 filler cards into the ‘already know’ pile. I then set aside all cards assigned to the ‘already know’ pile, plus any filler card that had been assigned to the ‘do not recognize’ pile. The resulting number of test *kanji* that participants identified as ‘do not recognize’ varied between 6 and 15.

Working solely with *kanji* the participant had identified as ‘do not recognize’, I presented 3 of those cards, randomly selected, with the instruction to try to memorize the shapes of those *kanji* within a 3-minute interval. I indicated that I would later ask the participant to recall their shapes from memory. No information about the sounds or meanings of the test *kanji* was given, and participants were disallowed use of a pen or pencil to rehearse the shapes of the *kanji* in writing.

As a covert test of whether inhibiting *kūsho* impairs learning, in the learning phase of Task 1 in Part 1, I had 22 of the 44 participants cross their arms, bent at the elbow, in front of their chests, weaving one hand under the opposing upper arm and locking the other hand on top of its opposing upper arm. I asked them to maintain that posture while they memorized the first 3 test *kanji*, under the assumption that this restraint would prevent use of *kūsho*. The other 22 participants had free use of their hands and arms during the learning phase of Task 1 in Part 1. But to counterbalance a possible general decrement to learning induced by the imposition of a specific posture on learners, I asked the 22 participants whose hands were free to rest one foot on either the trestle foot of the table at which they were seated, or a nearby chair, or on a low stool or box (approximately 4 to 6

inches high) placed at about a 20-degree angle outside the central orientation of their seat.[6] Thus 22 participants completed the learning phase of Task 1 in Part 1 with their hands restrained, while the other 22 completed the same task with hands free—and therefore available to perform *kūsho*—but with one foot in a mildly restrained position.

After 3 minutes' exposure to the first 3 test *kanji* (or earlier if the participant felt ready), I removed the index cards and launched into the first of two short oral interviews. The purpose of the first interview was to collect demographic data and information about participants' language history, and also provide a brief distraction separating the first *kanji*-learning phase from the first *kanji*-recall phase. The first interview lasted an average of 2:43 minutes, with a range between 2:26 and 5:26 minutes. No physical restraints were imposed during the interview.

The next step comprised the recall phase of Task 1. Presenting the response booklet, I invited learners to write the first set of 3 novel *kanji* on the first page, one to a box and in any order, insofar as they were able to retrieve them from memory. The maximum interval allowed for retrieval was 3 minutes, although many learners finished earlier. No physical restraints were imposed during the recall phase.

This completed Task 1 of Part 1. Task 2 of Part 1 repeated the same steps: presentation of a different 3 randomly-selected *kanji* that the learner had identified as unfamiliar; 3-minute learning phase; second interview; 3-minute recall phase. (The second interview focused on the learner's experiences of writing Japanese by hand versus with electronic support.) However, in Task 2 the 22 learners who had performed the learning phase of Task 1 with hands restrained performed the learning phase of Task 2 with hands free and one foot restrained as a counterbalance. Conversely, learners who had completed

the learning phase of Task 1 with hands free completed the learning phase of Task 2 with hands restrained, as described above. In this way, each participant completed the two learning tasks, once with hands restrained, and once with hands free and thus available to perform *kūsho*, with the order of the restrained versus free hand positions counterbalanced over the total subject pool.

Part 2. Part 2 probed the use of *kūsho* during recall of *kanji* from long-term memory. It comprised 4 tasks, carried out in a fixed order without interruption and without imposing any physical restraint. All 4 tasks shared a similar procedure. Turning the response booklet to a fresh page for each task, I asked participants to write down from memory any 3 *kanji* they already knew, in response to a specific prompt. In order, the prompts were:

Task 3: *Kanji* cued by sound. 'Write down any 3 *kanji* which have the reading '*kō*' (i.e. *ko* + *u*, pronounced [ko:])'. The purpose was to observe whether participants employed *kūsho* to retrieve *kanji* when prompted to recall on the basis of sound.

Task 4: *Kanji* cued by meaning. 'Write down any 3 *kanji* which you can imagine using in composing an essay on the topic of travel'. As clarification, or if a participant needed help conceptualizing this prompt, I gave as examples English words such as 'suitcase', 'itinerary', 'train station', etc. The goal was to observe whether learners use *kūsho* in the retrieval of *kanji* by meaning.

Task 5: *Kanji* cued by perceived complexity. 'Write down any 3 *kanji* that you consider to have especially complex shapes'. Here the goal was to determine whether learners employed *kūsho* when prompted to retrieve *kanji* according to shape.

Task 6: *Kanji* cued by specified components. On the final page of the response booklet, to the left side of each of the three boxes in which participants wrote 3 recalled *kanji*, I printed a component that forms a relatively common subpart of certain *kanji*. Appendix D displays these components. The instruction was: 'Think of any *kanji* you know that contains the given component, and write that *kanji* in the adjacent box'. The goal was to determine whether retrieval of *kanji* according to shape induces learners to employ *kūsho*, but in this case with retrieval directed at specific *kanji* components.

At the conclusion of the research procedure, I disclosed to participants the focus of the study on the use of *kūsho*. Participants generally expressed surprise, and seemed unaware of the extent of their use of *kūsho*. Many commented that they had experienced learning *kanji* in the hands-restrained position noticeably more difficult than in the hands-free position. When questioned, no participant reported ever having been explicitly advised to employ *kūsho,* or having been instructed in its use as a technique for learning *kanji* in the course of instruction in Japan or abroad.[7]

Coding the Data

The procedures described above yielded four bodies of data bearing on research questions (1) through (4). The relevant data include: observations of participants' use (or non-use) of *kūsho* as captured in the video files; the completeness and accuracy of participants' reproductions of target *kanji*; information about learners' language backgrounds and experiences of L2 learning, gleaned from the two interviews in Part 1; and the time intervals participants required to complete each task. Analysis of these data took place as described below.

Use of *kūsho*

The video files showed that some participants used *kūsho* almost continuously while learning and recalling *kanji*. Others did so episodically but repeatedly throughout the test procedure; still others, strategically, limited to specific contexts. I developed a coding protocol that awarded participants separate numerical scores for use (or non-use) of *kūsho* in each of the two learning and recall phases in Part 1, and for each of Tasks 3 through 6 in Part 2. The scores represent how sustained employment of *kūsho* was, or, when employed episodically, how often its use was initiated. Scores ranged in whole numbers from 0 (no use of *kūsho*) to 5 (continuous use of *kūsho,* or sustained 'stop-and-start' *kūsho* with only brief pauses separating bouts of 'air writing'). Video Files #2 through #7, accessible online (see Appendix A) display representative participants' responses to various tasks in which they were awarded scores of 5 (maximal use of *kūsho*; two examples), 4, 2 (two examples), and 1 (minimal use of *kūsho*). Each participant's use of *kūsho* was assessed twice by the same rater to enhance consistency. A trained second rater then viewed and independently re-scored all 44 video files using the same coding scheme. Correlations across the two raters' results were calculated for the 8 tasks (2 learning and 2 recall phases in Part 1; Tasks 3 through 6 in Part 2). Pearson's r correlation coefficient was above 0.80 in all cases, with $p<0.001$ in every instance.

Coding the data for use of *kūsho* called attention to an unexpected finding. In Part 1, each participant learned novel *kanji* under two conditions, once with hands restrained (to inhibit *kūsho*) and once with hands free (to permit *kūsho*). For 10 out of the 44 learners, however, the crossed-arm posture imposed in the restrained condition proved insufficient to fully inhibit *kūsho*. These 10 participants spontaneously raised one or more fingers from

the crossed-arm position to perform *kūsho* against the side of their upper arm or torso, or in the air, sometimes sporadically, sometimes sustaining 'surreptitious' *kūsho* throughout the learning phase. The emergence of *kūsho* under these inhibiting conditions seems to signal that some participants found its cognitive value so irresistible that they were driven to discover a way to 'write in the air' while learning *kanji* despite instructions designed to prevent them from doing so. Video File #3 illustrates one participant's use of surreptitious *kūsho* while learning *kanji* in the hands-restrained condition.[8]

Accuracy of reproduction of *kanji*

I assessed the *kanji* that learners reproduced in the test booklets for accuracy in Part 1, assigning a whole-number accuracy score ranging from 0 (no response) to 10 (fully accurate reproduction of the target *kanji*). Following Onose (1987) and Hatta, Kawakami, and Tamaoka (1998), my scoring technique provided partial credit for correct formation and placement of the individual components that made up complex *kanji*.[9] See Appendix E for examples of participant-produced *kanji* and illustrations of how scores were assigned.

In Part 2, participants retrieved from long-term memory any 3 *kanji* they deemed relevant to a series of specific prompts. As in Part 1, the focus here is whether the participants used *kūsho* in the course of retrieval, but with the added wrinkle that Part 2 allows comparison of which prompts elicited more or less *kūsho*. Participants responded to Part 2 out of their own idiosyncratic inventories of learned *kanji*. In the absence of a convergent target of retrieval across all participants, a measure of accuracy of retrieval is therefore less telling. I do not report scores for accuracy of retrieval of *kanji* in Part 2.

Individual participant data

In the course of the two interviews conducted between the learning and recall phases of Tasks 1 and 2 in Part 1, I collected demographic data. This included the identity of learners' native language(s), and information about their length of study of Japanese, length of residence in Japan, and experiences as language learners.

Speed of learning and recall of *kanji*

Using the time stamp embedded in the video files, I calculated the length in seconds that each participant took to respond to each of the components of the research procedure, namely, the two learning and recall phases of Tasks 1 and 2 in Part 1, and the intervals expended in recall and writing of *kanji* in Tasks 3 through 6 in Part 2. I also calculated the length of the first and second interviews.

Results

To return to the four research questions posed above:

Do L2 learners employ *kūsho*?

Yes. L2 learners of Japanese employ abundant *kūsho* in learning and recalling *kanji*. Table 3 indicates the distribution of the use of *kūsho*, displayed as the numbers of participants who were assigned a score of 0 (no use of *kūsho*) through a score of 5 (sustained or consistently iterated use of *kūsho*), across the component tasks of Parts 1 and 2. Table 4 records the percentage of L2 learners who exhibited any use of *kūsho*, and the mean rates of use of *kūsho*, by task.

[Insert Tables 3 and 4 about here]

Of the 44 participants, every one unequivocally exhibited *kūsho* at least once. The most frequent context for use of *kūsho* was during the learning phase of Part 1, in the hands-free

condition. Forty-two out of 44 L2 learners exhibited *kūsho* in this context. Of the 42 learners who employed *kūsho* in learning *kanji* with hands free, 24 were assigned the maximum score of 5 for use of *kūsho*. The mean score for *kūsho* use across all 44 participants in this context was 4.00 (SD 1.43). Some participants wrote in the air, some on the desktop, some on their laps, some on the open palm of their non-dominant hand. Some produced *kūsho* in more than one location within the confines of this single task.

The second most frequent context for use of *kūsho* proved to be Task 6, where learners wrote from memory *kanji* that incorporated specific components: 36 of 44 L2 learners used *kūsho* in response to this prompt. The mean *kūsho* score across all 44 participants in Task 6 was 2.45 (SD 1.85). The third most frequent context for *kūsho* was Task 5, where learners recalled familiar *kanji* that they considered visually complex: 32 out of 44 learners exhibited *kūsho* in this context (mean 1.89, SD 1.63).

The least common context for production of *kūsho* proved to be the hands-restrained learning condition in Part 1, where participants folded their arms across their chests. This is not surprising, since I had anticipated that this posture would reduce display of *kūsho* to nil. Instead, it proved merely inhibiting, so that 10 of the 44 learners exhibited *kūsho* in this context (mean 0.66, SD 1.35).

In addition to executing *kūsho* in the course of learning and recall of *kanji*, learners sometimes used *kūsho* in other, unexpected, contexts. For example, 4 of the 44 participants exhibited *kūsho* during the *kanji* sorting task that preceded Task 1. This was unexpected, since at that point their only instruction was to sort the cards into piles representing '*kanji* I know' versus '*kanji* I don't know'; they had not yet been directed to learn the shapes of

kanji in preparation for recall. But for 4 learners, mere discernment of the recognizability of *kanji* elicited the practice of *kūsho.*

Another context where *kūsho* appeared was during the two oral interviews. Seventeen of the 44 learners (39%) spontaneously employed *kūsho* in the service of communication while answering questions—sometimes questions in English, sometimes in Japanese—about their language backgrounds, acquisition of Japanese, or experiences writing Japanese by hand versus on a keyboard. I do not analyze here the use of *kūsho* in learners' conversation, except to point out that its presence adds to the evidence that Tables 3 and 4 under-represent the full incidence of *kūsho* recorded in the video files.

In contrast to the L2 learners of Japanese, however, none of the 6 members of the comparison group (L2 learners of Spanish, French, or Russian) exhibited any hand movements that resembled *kūsho* when learning or recalling words in their L2. In post-test de-briefing, no comparison group member reported a habit of rehearsing the shape of an L2 word kinesthetically in the manner of *kūsho*, although several learners remarked that when faced with difficulty retrieving a word, they sometimes write out plausible alternatives (i.e. on scrap paper, with a pen or pencil) and inspect them visually. Although the comparison group is small, it provides no evidence that learners of non-*kanji* culture L2s practice *kūsho*-like behavior.

<u>Do L2 learners of Japanese employ *kūsho* at different rates in different tasks?</u>

Yes. Certain tasks elicit more *kūsho* than others. Table 4 shows that in Part 1, comparing the hands-free learning condition to the subsequent recall phase, twice as many learners used *kūsho* while learning than while recalling *kanji*. The rate of use of *kūsho* is four times higher while learning compared to recalling. The hands-restrained learning

condition in Part 1put a damper on the use of *kūsho* among some, but not all, participants, so that in this case more *kūsho* emerged, across more participants, in recall compared to learning. It appears, however, that although *kūsho* has a role in both learning and recall, in the absence of restraint it is more widely and more intensively employed while memorizing *kanji* than while retrieving *kanji* from short-term memory.

Table 4 also shows that learners of Japanese employed *kūsho* strategically, at different rates in different tasks within Part 2, when recalling *kanji* from long-term memory, in particular, Tasks 5 and 6 elicited use of *kūsho* from more participants, and at higher rates, compared to Tasks 3 or 4. Within-subjects ANOVA indicated that the overall differences among the four tasks in Part 2 were statistically significant ($F=14.06$, $df=3$, $p<0.001$). Post-hoc analysis was conducted to examine pair-wise differences. Comparison of the mean rates of *kūsho* usage between Tasks 3 and 5, and between Tasks 3 and 6, yielded evidence of statistically significant differences in both cases (comparing Tasks 3 and 5: $F=14.94$, $p<0.001$; comparing Tasks 3 and 6: $F=27.07$, $p<0.001$). Likewise, comparison of the mean rates of *kūsho* use between Tasks 4 and 5, and between Tasks 4 and 6, yielded evidence of statistically significant differences in both cases (comparing Tasks 4 and 5: $F=21.75$, $p<0.001$; comparing Tasks 4 and 6: $F=31.79$, $p<0.001$). We can conclude that prompting learners' retrieval of *kanji* by shape in Tasks 5 and 6 elicits significantly more use of *kūsho* relative to prompting them to retrieve *kanji* by sound (Task 3) or meaning (Task 4).

<u>Are there perceptible individual differences among L2 learners in the use or non-use of *kūsho*?</u>

Yes. Learners with longer residence in Japan tended to use more *kūsho*. Comparing participants' total *kūsho* score against their numbers of months of residence in Japan, a mild correlation emerged (Kendall's tau=0.276, p=0.01; Spearman's rho=0.393, p=0.008; Pearson's r was insignificant because of the non-normal distribution for length of residence in Japan). Although there are likely many factors bearing on the use of *kūsho*, this finding suggests that one factor is the extent to which a learner has been exposed to the orthographic practices modeled by native speakers of Japanese in the context of living in Japan. No statistically significant correlation emerged between learners' length of study of Japanese and their use of *kūsho.*

It is noteworthy that, in 7 of the 8 learning or recall tasks, L2 learners whose L1 is Chinese or Korean (n=16) did not exhibit *kūsho* at rates significantly different from those of L2 learners from non-*kanji* cultures (n=28). Overall, the total rate of *kūsho* produced was almost identical for the *kanji* versus non-*kanji* culture groups (mean difference=0.313, t=0.141, df=42, p=0.889). The one exception was the hands-restrained learning condition: among the 10 L2 learners who produced surreptitious *kūsho* in that context, 9 were native speakers of Chinese, so that comparing the output of *kūsho* between *kanji* and non-*kanji* culture groups for this task yielded a mean difference of 0.830, t=2.040, df=42, p=0.048. The marginal level of significance to this finding deserves more research against a background of evidence that L2 learners from non-*kanji* cultures generally do not employ *kūsho* at different rates than L2 learners from *kanji* cultures.

Does the rate of use of *kūsho* correlate with: (a) the interval required for recall; (b) accuracy of recall of newly-learned *kanji*?

(a) Yes, there is evidence of a relationship between the interval required for recall and learners' use of *kūsho*. In Part 1, learners who took longer to recall novel *kanji* used significantly more *kūsho*, after both the hands-free and hands-restrained learning conditions. Following hands-free learning, use of *kūsho* correlated with the length of the interval required for recall (Pearson's r=0.477, p=0.001), and likewise following hands-restrained learning (Pearson's r=0.627, p<.001). This finding suggests that the longer the interval required to retrieve recently-learned *kanji*, the more likely learners are to rely on *kūsho* to support retrieval. Similar correlations emerged across Part 2. When learners recalled *kanji* from long-term memory, the longer the interval required for recall, the more *kūsho* used in Task 3 (Pearson's r=0.351, p=0.019), Task 4 (Pearson's r=0.631, p<.001), Task 5 (Pearson's r=0.354, p=0.018), and Task 6 (Pearson's r=0.523, p<.001).

(b) The data do not provide strong evidence that the practice of *kūsho* while learning *kanji* correlates with accurate recall of those *kanji*: for the hands-free learning condition in Part 1, Pearson's r=0.273, p=0.073.[10] Therefore, it is not clear that learners who use more *kūsho* while LEARNING novel *kanji* are better able to retrieve their shapes from short-term memory. However, when learners RECALL novel *kanji*, a negative relationship emerged between accuracy and the use of *kūsho*: learners who were less accurate in their reproductions of newly-learned *kanji* used more *kūsho* when trying to recall those *kanji* (Pearson's r=-0.44, p=0.003). One feasible interpretation of this result is that more use of *kūsho* signals greater perceived difficulty—and therefore often less success—in recall. Conversely, learners who readily access the target *kanji* in memory do not need extra kinesthetic help; they complete recall quickly and accurately, without employing *kūsho*.[11]

Does preventing learners from employing *kūsho* inhibit learning or recall?

I anticipated that the results in Part 1 might indicate a difference in the accuracy of recall of novel *kanji* following the hand-restrained learning condition (aimed to inhibit *kūsho*) versus following the hands-free learning condition (which made *kūsho* an option). However, the accuracy with which learners recalled *kanji* in these two contexts proved almost identical (mean difference=0.023, t=0.026, df=43, p=0.980). Even taking into account that the practice of surreptitious *kūsho* during the hands-restrained learning phase by 10 of the 44 participants disrupts these data, my findings do not evince a direct relationship between spontaneous use of *kūsho* in learning novel *kanji* and accuracy of subsequent recall. This result is corroborated by the lack of a statistically significant correlation between the overall amount of *kūsho* produced in the learning and recall tasks of Part 1 and the overall accuracy of recall of *kanji* in Part 1 (Pearson's r=-0.179, p=0.244).

Discussion

The data reported here directly address the central questions of this research project. Moreover, reading between the lines of those data opens additional insight into the status of *kūsho* within the literacy repertoire of L2 learners of Japanese. In particular, the data illustrate how unconscious, but how compelling, *kūsho* may be. In post-test debriefing, no participant claimed to have been instructed in the practice of *kūsho,* or to have discussed its use in an instructional context. Although all remembered observing other people using their hands in this manner, a few remarked that they themselves did not employ *kūsho*—a statement at odds with the freshly-collected video evidence of their own behavior. More evidence of the involuntary nature of the practice of *kūsho*, and of its value to learners,

comes from the 10 of the 44 participants who unwittingly employed surreptitious *kūsho* during the hands-restricted learning phase in Part 1, where its expression is tacitly constrained; and from the fact that a number of learners volunteered following the research procedure that restraining their hands while learning *kanji* increased their subjective sense of the difficulty of the task, or that doing so 'felt really unnatural'. Taken together, these observations characterize the utility of *kūsho* to L2 learners, despite the low profile it holds among their self-conscious literacy practices.

The phenomenon of *kūsho* is also worth considering with respect to L2 pedagogy. Matsuo *et al.* (2000, 2001, 2003) has examined the neurolinguistic basis of motor skills and *kanji* processing among native speakers of Japanese. In one study, Matsuo *et al.* (2003) had 12 native speakers either view *kanji* or recall them by sound, and then count the numbers of strokes they contained under two conditions: while using *kūsho,* or without moving their hands. Functional magnetic resonance imaging during stroke-counting showed that *kūsho* perceptibly lightened the neural load of the task, whereas suppressing movement increased neural activation. This surprising finding—that the absence of movement of the hands increased neural activation relative to the lower level of neural activation during active *kūsho*—is consistent with other research indicating that suppression of *kūsho* reduced native speakers' capacity to perform certain tasks with *kanji* (Sasaki and Watanabe 1983; Haga 2009), and with L2 learners' report that restraining their hands increased their subjective sense of the difficulty of learning *kanji.* Conversely, Nozaki *et al.* (2004) reported the success of a pilot study that incorporated *kūsho*-like hand movements in a computer-mediated program for instruction of learning-disabled child writers of Japanese. Hoosain (1991:159–160) reviewed research on the value of 'finger tracing' of

characters as a therapy for native speakers of Chinese recovering from aphasia. Returning to the present research, recall that the findings failed to show that suppressing *kūsho* inhibited L2 learning of *kanji*. However, it is still worth exploring whether *kūsho* might have a measureable, positive, effect on L2 learning or recall: first, because the failure to find an effect of the suppression of *kūsho* is obscured by the fact that 10 of the 44 participants produced surreptitious *kūsho* in the hands-restrained condition; second, because self-conscious, deliberate, incorporation of *kūsho* into instruction in Japanese may have a more pronounced effect than when its use is left up to the spontaneous initiative of learners.[12]

The issue of whether *kūsho* can be shown to have a facilitative role in L2 acquisition of *kanji* is of particular timeliness granted the massive on-going shift in contemporary Japan from writing generated by hand, to writing generated by keyboard-based technology (Kess and Miyamoto 2001). The computerization of writing has extensive consequences for Japanese psycholinguistics (as it does for education, aesthetics, social conventions, labor politics, and many other topics discussed by Gottlieb 2000). Producing a text in Japanese by hand is a different cognitive and motor skill compared to producing a text in Japanese via a keyboard, where characters are retrieved in cohorts by typing their phonetic representations, then selecting the target *kanji* from a computer-generated menu of homophones. Computer-supported literacy demands neither the fine-grained memory for detail, nor the extensive capacity to discern and reproduce complex visual patterns, nor the highly developed motor skills that conventional competence in Japanese handwriting demands (Chikamatsu 2003; Dixon 2010). *Kūsho* seems to build up (and, perhaps, emerge out of) precisely those skills. What might be the relationship between the displacement of handwriting by modern keyboard-based writing and the practice of *kūsho*? A preliminary

finding from the present research suggests that more extensive use of keyboard-based writing correlates with more employment of *kūsho.* As part of the second interview task, participants were asked to estimate the percentage of their current writing in Japanese that is done by hand versus by keyboard. (The range reported was from 5% to 99%; average 57.8%; 1 out of 44 participants reported no writing by keyboard.) Keyboard-based writing weakly correlated with participants' employment of *kūsho*, at a level that approached statistical significance (Pearson r=0.31, p=0.05). More explicit data are required to rule out confounding factors, but whether a relationship exists between the proportion of handwriting versus keyboard-based writing and the employment of *kūsho* warrants further investigation, as does the question of whether *kūsho* can play a facilitative role in L2 acquisition of *kanji* in the age of the word-processor.

Conclusion

This research has shown that some L2 learners of Japanese exhibit *kūsho* lavishly, others sparsely; but every learner employed *kūsho* in at least one context. Individual variation can be partially associated with context-independent factors such as learners' length of residence in Japan. Learners from *kanji* cultures (i.e. native speakers of Chinese or Korean) do not overall produce more *kūsho* than learners from non-*kanji* cultures. *Kūsho* most commonly emerged in learning novel *kanji*, and when prompted to recall familiar *kanji* by shape. Moreover, greater use of *kūsho* correlated significantly with lower accuracy at recalling *kanji* from short-term memory in Part 1, and with longer intervals taken to recall *kanji* from long-term memory in Part 2. These findings are consistent with previous research with native speakers, which depicts *kūsho* as a device for facilitating *kanji*

retrieval. The data do not, however, show that suppressing *kūsho* while learning novel *kanji* significantly decreased accuracy of recall.

This inquiry into the little-acknowledged phenomenon of *kūsho* suggests that the conventional, three-sided representation of *kanji* as comprising sound, form, and meaning omits a fourth fundamental facet, namely, the kinesthetic content of *kanji*. Pioneering research in the 1980s hypothesized that native speakers use ‘air writing’ to facilitate learning and retrieval of *kanji*, a result supported by recent neurolinguistic studies. More work needs to be done to better understand the psycholinguistic and cultural status and role of *kūsho* in the orthographic practices of native speakers—and, given the results reported here, in the orthographic practices of L2 learners as well.

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Notes

[1] Two limits to the scope of this article are that (a) it addresses *kūsho* only in Japanese, whereas speakers and writers of Chinese also employ what may be an identical practice (see Hoosian 1991 and Yim-Ng, Varley, and Andrade 2000 on 'finger tracing' in Chinese); and (b) it excludes discussion of *kūsho* in face-to-face conversation, although for an illustration see Appendix A, Video File #1, and for discussion see Thomas (in preparation[a]).

[2] Despite the long-sustained convention of using repetitive writing in the service of memorizing *kanji*, some scholars have questioned its efficacy (Naka and Naoi 1995; Naka and Takizawa 1990). See Nihei (1986, 1988) for research on motoric memory and the acquisition of *kanji* from another perspective.

[3] Moreover, inspection of the video files described below suggests that the movements that make up *kūsho* are often executed in a single location, without advancing the hand forward incrementally from top to bottom across a page (or left to right) as one would when writing a series of visible characters with a pen. This is another sense in which *kūsho* is 'abstract' and distinct from material writing practices.

[4] A handbook analyzing gesture in Japanese culture (Hamiru-aqui 2004) contains no reference to *kūsho*, nor does a journal article comparing the use of gestures in Japanese versus English speakers (Brown 2008).

[5] In research on L2 learners' cognitive processes in *kanji* recognition, Toyoda (2009) highlights the salience of components out of which characters are composed. She shows

that learners gradually learn to recognize components and how they are positioned and combined.

[6] See Goldin-Meadow, Nusbaum, Kelly, and Wagner (2001) for research showing that restraining hand gestures inhibits memory during a verbal explanation task. Frick-Horbury and Guttentag (1998) found a similar effect in a lexical retrieval and free recall task.

[7] One participant, a native of Italy, explained that in a first-year language class in Italy the teacher (a native speaker of Japanese) sometimes directed students to 'write *kanji* in the air' while seated at their desks and facing the front of the classroom. He explained that the teacher used this technique to ensure full participation across a class of 40 students. The class was not, however, taught *kūsho* as a technique for private use as an adjunct to the memorization of *kanji*.

[8] In pre-tests of the experimental protocol, I had native speakers sit on their hands as one learning condition in Part 1 (adapting Sasaki and Watanabe's [1983] strategy). However, in post-test debriefing, several participants volunteered that while sitting on their hands, they had shifted their weight to free up a fingertip with which they executed *kūsho* under their thigh, in a position where I could not observe its use. Therefore with the L2 learners, I substituted a crossed-arm position on the logic that if surreptitious *kūsho* was necessarily going to take place, it is advantageous to make it observable. It is also salient that the research assistant who recorded the video files reported that an occasional participant performed foot movements under the table that

resembled *kūsho*. These movements proved difficult to capture on video and are excluded from analysis, but may constitute an additional kind of surreptitious *kūsho.*

[9] In a few instances participants in this study who were native speakers of Chinese produced simplified Chinese versions of Japanese *kanji*. I consulted with teachers of Chinese to distinguish faulty representations of the target *kanji* (assessed according to the scale articulated in Appendix E) and correct Chinese-style versions of Japanese *kanji* (not treated as errors).

[10] In the hands-restrained learning condition, use of *kūsho* was likewise not correlated with accuracy of recall of *kanji* (Pearson's r=0.218, p=0.154). However, recall that the overall rate of use of *kūsho* in this context was suppressed by design.

[11] Another interpretation of this finding is that use of *kūsho* reduces accuracy of recall. The present data cannot rule out that interpretation, but it is rendered less plausible on two grounds: (1) previous research with native speakers of Japanese (e.g. Sasaki 1987; Endo 1988; Haga 2009) has shown that *kūsho* facilitates recall of *kanji*; (2) in post-test de-briefing, many participants in the present study expressed a contrary perception that suppressing *kūsho* had inhibited their capacity to learn.

[12] Results from a study now underway (Thomas, in preparation[b]) indicate that, in fact, when L2 learners are directed to self-consciously employ *kūsho* in a *kanji*-learning task, their accuracy of recall increases.

Table 1

Age, Length of Study of Japanese, and Length of Residence in Japan of the L2 Learners

	n	Mean	Range	SD
Age (in years)	44	26.5	19–51	6.45
Years prior study of Japanese	44	5.5	1–17	3.95
Months living in Japan	44	36.8	2–204	48.63

Table 2

Native Languages of the L2 Learners

	n	% of total group
Learners from '*kanji* cultural area[s]' (Sasaki 1987: 135)		
Chinese	14	31.8%
Korean	2	4.5%
Learners from non-*kanji* cultures		
English	12	27.3%
German	5	11.4%
Dutch	2	4.5%
Polish	2	4.5%
Vietnamese	2	4.5%
French	1	2.3%
Italian	1	2.3%
Russian	1	2.3%
Spanish	1	2.3%
Thai	1	2.3%

Table 3

Use of *Kūsho* by L2 Learners (*n* = 44), by Number of Learners Assigned Scores from '0' (No Use of *Kūsho)* to '5' (Maximum Use of *Kūsho*), by Task

	Kūsho score					
Task	0	1	2	3	4	5
Part 1, Tasks 1 & 2						
Hands-free learning phase	2	2	2	6	8	24
Recall phase (following hands-free learning)	23	10	6	1	3	1
Hands-restrained learning phase	34	1	3	3	2	1
Recall phase (following hands-restrained learning)	26	9	5	2	1	1

Table 3, con't.

	Kūsho score					
Task	0	1	2	3	4	5
Part 2						
Task 3 Prompted by sound	25	8	5	4	0	2
Task 4 Prompted by meaning	23	10	8	0	3	0
Task 5 'Maximally complex shape'	12	8	9	7	4	4
Task 6 Prompted by component shapes	8	10	5	5	7	9

Table 4

Use of *Kūsho* among L2 Learners (*n* = 44), by Number of Learners Exhibiting *Kūsho* and Mean Rate of Use of *Kūsho*, by Task

Task	Number of learners exhibiting use of *kūsho* (% out of *n* = 44)		Mean rate of *kūsho* for *n* = 44; range = 1[low] to 5 [high] (SD)	
Part 1, Tasks 1 & 2				
Hands-free learning phase	42	(95.5%)	4.00	(1.43)
Recall phase (following hands-free learning)	21	(47.7%)	0.95	(1.33)
Hands-restrained learning phase	10	(22.7%)	0.66	(1.35)
Recall phase (following hands-restrained learning)	18	(40.9%)	0.77	(1.20)

Table 4, continued

Task	Number of learners exhibiting use of *kūsho* (% out of *n* = 44)		Mean rate of *kūsho* for *n* = 44; range = 1[low] to 5 [high] (SD)	
Part 2				
Task 3 Cued by sound	19	(43.2%)	0.91	(1.34)
Task 4 Cued by meaning	21	(47.7%)	0.86	(1.15)
Task 5 ‘Maximally complex shape’	32	(72.7%)	1.89	(1.63)
Task 6 Cued by component shapes	36	(81.8%)	2.45	(1.85)

Appendix A

Contents of the Video Files, Viewable at http://capricorn.bc.edu/airwritingL2japanese/index.html

To access files online, login using username 'AirWriteinL2J' and password 'Kuusho'

Video file #	Task	Source	Score for use of *kūsho* (range 1–5)	Comments
1	Free conversation	Colligan-Taylor (2007)	n / a	*Kūsho* in conversation (at 2:11:35; again at 2:11:40), executed in mid-air, outside of speaker's direct gaze
2	Part 1, learning phase, hands free	L2 learner, first language (L1) French	5	*Kūsho* executed continuously on desktop with fingertip, both inside and outside learner's visual field, while learning novel *kanji*
3	Part 1, learning phase, hands restrained	L2 learner, L1 Italian	5	'Surreptitious' *kūsho* executed continuously with fingertip of restrained hand outside learner's visual field, while learning novel *kanji*

Appendix A, continued

Video file #	Task	Source	Score for use of *kūsho* (range 1–5)	Comments
4	Part 1, learning phase, hands free	L2 learner, L1 Chinese	4	Frequent but discontinuous *kūsho* executed in the air, under the table, on palm of non-dominant hand; inside and outside of learner's visual field
5	Task 4, recall of *kanji* by sound	L2 learner, L1 Vietnamese	2	Sporadic execution of large, abstract, *kūsho* in the air over desktop, with hand holding a pen, while recalling familiar *kanji* by sound
6	Task 6, recall of complex *kanji*	L2 learner, L1 Polish	2	Single sustained *kūsho* executed in the air (from 0.50 to 1:04), outside learner's visual field
7	Task 7, recall of *kanji* by component	L2 learner, L1 English	1	Single very brief *kūsho* executed on the desktop (at 0:24) outside learner's visual field

Appendix B

The Comparison Group

The comparison group comprised 6 L2 learners whose ages, backgrounds, and exposure to the L2 were commensurate with those of the Japanese-learning participants but without exposure to Japanese, Chinese, or Korean. Their ages ranged from 22 to nn, and their years of study of their L2 from x to Z. All were female; 4 were college students, one a recent college graduate, and one formerly a language teacher of her L2 at the college level. Two were learners of Spanish, 2 of French, and 2 of Russian, with a minimum of 2 months experience living in their target-language speaking communities (range x to y). The goal was to determine whether learners of 'non *kanji*-culture' languages employed any practice like *kūsho*.

I videotaped comparison group members completing versions of Parts 1 and 2 (adapted as described below to their relevant L2) and scrutinized the resultant 6 video files for the use of hand movements that resembled *kūsho*. The language used throughout the procedure was English.

To replace the *kanji* memorization and recall task in Part 1, I selected words I presumed to be rare from Spanish, French, or Russian dictionaries, then confirmed that judgment with teachers or native speakers of these languages. Separately for Spanish, French, and Russian, I then entered 15 test words on index cards along with 7 easier, filler, words in those languages, creating three separate test batteries, one each in Spanish, French, and Russian. I modified the test booklet to allow comparison group participants to

enter words into it using the conventional horizontal, left-to-right, orientation shared by their L2 orthography.

For Part 2, I adapted the instructions and materials as follows:

For Task 3, for learners of Spanish, the instructions were to write down any three words that include the sound /kɛ / (‘que’); for learners of French, /bʀ o/ (‘bro’); for learners of Russian, /tr a/ (‘тра’).

For Task 4, ‘Write down any three words in your L2 that you could imagine using in composing an essay on the topic of travel.’

For Task 5: ‘Write down any 3 words in your L2 that you consider to have especially complex spellings.’

For Task 6, the prompts comprised the following parts of words: for learners of Spanish, *ini, ü, ozo*; for learners of French, *aï, œ, cqu*; for learners of Russian, *ИН, ЫД, ПЛ*.

Appendix C

Target *Kanji* Used in Part 1

Reproduced with identifying 'Nelson number' (Nelson and Haig 1997:ix–x)

Filler *kanji*: included in the array, but excluded from the learning and recall tasks

1. 別 467
2. 機 2880
3. 特 3541
4. 預 6625
5. 細 4472
6. 黄 7045
7. 顧 6655

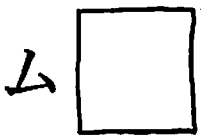
Test *kanji*: included in the array and used in the learning and recall tasks

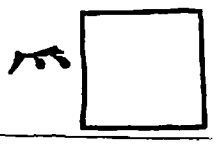
8. 贔 4674
9. 儼 339
10. 劉 918
11. 鷙 6997
12. 擒 2289
13. 鬱 2926
14. 嚊 3771
15. 蠾 5408
16. 鑒 6125
17. 鑞 6367
18. 斃 2363
19. 罐 4632
20. 饂 6713
21. 鷹 7007
22. 齏 7087

Appendix D

Prompts Used in Part 2, Task 5

1. 

2. 

3. 

Note: The instructions for Task 5 directed participants to provide, in the box to the right, any one *kanji* that incorporated the component on the left.

Appendix E

Assessment of Elicited *Kanji*: Illustrations of How Learners' Output was Scored in Part 1

Description of coding category	Target *kanji*	Example of learner's elicited reproduction	Score
Accurate reproduction	鷭		10 points
1 detail missing, added, or inaccurate	擒		9 points
2 details missing, added, or inaccurate	儼		8 points
1 component missing, added, or inaccurate, deforming no more than 25% of surface area	鬱		7 points

Appendix E, continued

Description of coding category	Target *kanji*	Example of learner's elicited reproduction	Score
1 or 2 components missing, added, or inaccurate, deforming more than 25% but less than 50% of surface area	饐		6 points
2 components missing, added, or inaccurate; deforming no more than 50% of surface area	齏		5 points
Between 50% and 75% of surface area deformed by missing, added, or inaccurate components	蠹		4 points

Appendix E, continued

Description of coding category	Target *kanji*	Example of learner's elicited reproduction	Score
75% or more of surface area deformed by missing, added, or inaccurate components	擒		3 points
(Only) 1 component, or 2 details, accurately represented	贏		2 points
(Only) 1 detail accurately represented	罐		1 point