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## A role for “air writing” in second-language learners’ acquisition of Japanese in the age of the word processor\*

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This article addresses the pedagogical implications of *kūsho* (空書; literally “air writing”), that is, the spontaneous manual tracing of Sino-Japanese characters (*kanji*) in the air with a bare fingertip, by learners of Japanese. I describe the phenomenon of *kūsho*, then review research indicating that it is common (if under-recognized) during *kanji* learning and recall and, moreover, is associated with a small but statistically significant advantage over conventional paper-and-pencil copying as a technique for memorizing the shapes of *kanji*. I propose that teachers of Japanese explicitly sanction *kūsho* and encourage students to self-consciously incorporate it into their repertoire of techniques for memorizing or recalling *kanji*. The issue is particularly salient in the context of the ongoing cultural shift away from writing by hand to computerized word processing, which in this generation is reshaping the psycholinguistics of literacy in Japanese. Practice of *kūsho* may secure a kinesthetic basis for facility with *kanji* among learners for whom keyboard-based typing is rapidly displacing manual writing.

Areas of interest: *kūsho*/*karagaki*/finger tracing; orthography of Japanese; L2 acquisition of Japanese *kanji*; kinesthetic learning; effects of technological change on L2 learning

### 1. Introduction

*Kūsho* (空書, literally “air writing”) is the name given to an intriguing, little-studied, phenomenon that brings together language, gesture, and the psycholinguistics of a logographic orthography. Although the word “*kūsho*” has little currency among native speakers or second language (L2) learners, anyone who is even marginally literate in Japanese seems to recognize the practice of air

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<sup>1</sup> See Thomas (2103; forthcoming) for links to video files accessible online which illustrate varieties of *kūsho*.

writing. It is probably fair to say that all writers of Japanese employ *kūsho* at least occasionally.

### 1.1. What does *kūsho* look like?

There are several conspicuous styles of *kūsho*. In every case, the practice consists in spontaneous, highly articulated movements of the fingers of the dominant hand, tracing the shape of a Sino-Japanese character, or *kanji*, presumably as a kinesthetic aid to learning and recall. Sometimes writers employ tiny, subtle gestures, bracing the heel of the hand against a surface and moving only the tip of the index or middle finger (or the tips of the index finger and thumb joined in a “pinching” configuration) over an area the size of a postage stamp. Other times writers extend the index finger in midair in a pointing gesture directed away from their body, then loosely rotate the full finger at the metacarpophalangeal joint (where the finger meets the palm), often while allowing a secondary pivot for motion at the wrist joint. More athletic styles of *kūsho* also exist, in which the whole arm is set in motion from the shoulder, inducing sympathetic movement of the trunk and sometimes head. The movements entailed can be smooth and rhythmic, or jerky and explosive. The *kūsho*-producing finger may be oriented toward, sometime touching, the surface of a desk or the side of the writer’s outer thigh. Alternatively, the fingertip may trace *kanji* in space, unsupported by any surface. There is in addition a variety of *kūsho* in which a writer holds a pen or pencil in the normal manual position, but lifts its point off the writing surface to rehearse the shape of a *kanji* in the air without leaving any material residue.

Although some writers execute *kūsho* in the air directly in front of their face, they usually do not fix their gaze on the *kūsho*-producing hand. The coordination of hand and eye varies from person to person and moment to moment in the performance of *kūsho*: some glance at their fingers periodically, but often the eyes are upturned, averted away from the hands, or even closed. This effect is most striking when a writer produces *kūsho* directly in front of his or her face, while averting the gaze to the side or looking up at the ceiling, in what appears to be a deliberate effort to avoid visual input from the movements of the hand.<sup>2</sup>

### 1.2. In what contexts is *kūsho* employed?

Observation of the naturalistic practices of both native and non-native speakers of Japanese, supplemented by the research reported below, indicates that *kūsho* is employed in three distinct contexts. One is during the acquisition of novel *kanji*, when learners freely use air writing as either an adjunct to, or a substitute for, the conventional technique of memorization—namely, iterative paper-and-pencil copying of the target character (Naka, 1998). Elementary school teachers in Japanese schools typically lead their youngest students in choral practice of *kūsho* as they learn the prescribed stroke order of *kanji* components, a teaching technique

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<sup>2</sup> See Thomas (2103; forthcoming) for links to video files accessible online which illustrate varieties of *kūsho*.

that probably induces the habit of associating movement with memorization (Bourke, 1996; Mann, 1985).<sup>3</sup> Japanese students up to the post-secondary level can be observed commuting to school on trains and buses while putting the finishing touches on their preparations for class: one hand holds a sheaf of papers while the other hand executes *kūsho* in the air or on their lap.

A second context for the performance of *kūsho* has been the focus of a small body of research by psychologists and educators since the 1980s. This research, almost exclusively conducted with native speakers rather than second-language learners of Japanese, has probed the role of *kūsho* as a kinesthetic cue in the recall of already-learned *kanji*. Pioneering work by Sasaki (1984, 1987) and Sasaki and Watanabe (1983, 1984) asked native speakers of different ages to integrate specific *kanji* components into full Japanese characters that they retrieved from memory, under various experimental conditions that alternatively allowed, required, or prevented use of *kūsho*. One of the most striking findings is that adult native speakers’ performance on the *kanji* integration task deteriorated when they were prevented from using *kūsho* relative to their performance when *kūsho* was allowed. The difference was statistically significant. This suggests that *kūsho* facilitates the processing and recall of familiar characters, at least when participants are attending to the shape of *kanji*. Later research by Murakami (1991) built on that result, demonstrating that adult writers used *kūsho* to recall *kanji* on the basis of meaning. Sumiyoshi (1996) reported that native speakers of Japanese (and of Chinese; see below) who were L2 learners of English used *kūsho* in a task that involved remembering the spellings of English words.

A third context in which *kūsho* figures is in face-to-face oral communication. Casual, seemingly unconscious use of “conversational *kūsho*” as a communication strategy can be observed among speakers of Japanese under several circumstances. One circumstance is when a speaker lacks confidence in the successful transmission of a message: for example, when he or she recognizes the need to disambiguate a potentially homophonous utterance, or to clarify an unusual reading of a character. Another context for conversational *kūsho* occurs when a speaker wishes to draw metalinguistic attention to a specific character, bringing special focus to bear on some facet of it (sound, meaning, or form). When speakers introduce *kūsho* into oral communication for one of these reasons, they often trace the shape of the relevant character with a finger of the dominant hand on the open palm of the non-dominant hand, tilting the palm in the direction of the listener. Or, a speaker may simply “write in the air” somewhere on the edge of the space between speaker and hearer.

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<sup>3</sup> However, data gathered through interviews with 13 native speakers (Thomas, in preparation) indicated that *kūsho* is not routinely taught as an instrument for private memorization or recall of characters, outside of the instructional context where the attention is on acquiring correct stroke order. Likewise, all of the 119 L2 learners of Japanese studied by Thomas (2013, forthcoming) unanimously denied having been taught to perform *kūsho* as a self-conscious mnemonic device. Rather, most learners claimed to have adopted the practice when they observed others using it and independently recognized its utility. A few learners asserted that they had spontaneously invented *kūsho*.

Conversational *kūsho* is common but has a low profile in speakers' awareness of their communicative behavior. It seems to be even less acknowledged than the use of *kūsho* in learning or recollection of *kanji*, and has very rarely been the object of research (but cf. Cibulka 2013; Thomas, in preparation). The discussion below addresses only *kūsho* as an orthographic practice in Japanese.

### 1.3. Who uses *kūsho*?

The existing research on *kūsho* assumes that it is restricted to writers of languages with logographic orthographies, specifically, what Sasaki (1987, p. 135) and Sasaki and Watanabe (1984, p. 190) call the “*kanji* culture[s]” of Japanese and Chinese. There is a small literature on an apparently identical practice among native speakers of Chinese writing in Chinese, analyzed under the name of “finger tracing” (Hoosain, 1991; Yim-Ng, Varley, & Andrade, 2000). Sasaki (1987) and Sasaki and Watanabe (1984) report that both native speakers of Japanese, and native speakers of Chinese learning Japanese, employ *kūsho* in performing a *kanji* integration task in Japanese. In a separate experiment involving spelling words in L2 English, native speakers of Japanese extended *kūsho* to the task of spelling English words.<sup>4</sup> In contrast, Sasaki (1987) reported that only 2 out of 23 learners of English from “non-*kanji* cultures” who were living in Japan displayed *kūsho* when writing in L2 English; of those two learners, Sasaki singled out one as an “exceptional student” of Japanese (p. 143). A small pilot study reported in Thomas (2013) tested the L2 writing behavior of native speakers of English who had no exposure to any “*kanji*-culture” language, and who had never visited Japan or China. These learners did not show any evidence of *kūsho*-like behavior in their L2s of Spanish, French, or Russian.

Taken together, research from the 1980s suggests that native speakers of “*kanji* culture” languages extend their practice of *kūsho* to other languages they encounter, both logographic and non-logographic, whereas native speakers of non-logographic languages do not normally display *kūsho*-like behavior when learning other non-logographic languages. What the research reported below in Section 2 adds to these early findings is that native speakers of non-logographic languages who are studying Japanese *do* readily acquire the habit of air writing in their L2 Japanese.

Examining the issue of who uses *kūsho* from a different direction, Sasaki (1984, 1987) analyzed how it develops from childhood as speakers of Japanese acquire literacy in their L1. Presenting 447 Japanese-speaking school-aged children with a *kanji* anagram task, he observed that *kūsho* first emerged at around age 8 years, then increased in frequency at a steep rate up to age 10. Moreover, Sasaki noticed that although more than half of the 9- and 10-year olds performed *kūsho* in space, by age 12 that proportion drifted downward to less than 30%, with older children replacing air writing in space for finger writing on a surface. It

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<sup>4</sup> Endo (1988) likewise found that Japanese speakers employ *kūsho* when writing in English; see also Sumiyoshi (1996).

remains unclear whether this shift in the style of performance of *kūsho* (from moving a finger in space, to air writing on a surface) represents a statistically significant developmental trend, or even whether differences in the style of execution of *kūsho* are psycholinguistically salient.

#### 1.4. Why do writers use *kūsho*?

There is varied, if fragmentary, evidence to support the assumption that *kūsho* serves as a kinesthetic aid in the recall of *kanji* by native speakers of Japanese. Sasaki (1983, 1987) and Sasaki and Watanabe (1983) provide the best evidence to date. Recall that their research reported that, in a *kanji* integration task, native speakers of Japanese were significantly less successful at integrating components (presented visually) into recognizable *kanji* when researchers prevented them from using *kūsho*. Endo reported a tangential finding: that native speakers of Japanese performed better in an L2 English spelling task when they were allowed to trace the shape of the target word with a fingertip on a blank piece of paper, relative to their performance when this *kūsho*-like behavior was inhibited. In another related study, Haga (2009) found that native speakers of Japanese were more accurate at counting the numbers of strokes required to write common *kanji* when they could move their hands freely, compared to when their hand movements were restricted. There is also a small body of provocative neurolinguistic data. Matsuo *et al.* (2003) used fMRI to demonstrate *reduced* activation of the left premotor area of the brain when native speakers used *kūsho* to count the strokes of *kanji* displayed visually, relative to the levels of activation induced in that area of the brain when the task was repeated while preventing use of *kūsho*. Matsuo *et al.* (2003, p. 263) conclude that *kūsho* “lightens neural loads” in the processing of *kanji*.

There are still many questions remaining about the role of *kūsho* in the psycholinguistics of Japanese. In particular, we need to better understand the relationship of *kūsho* to conventional, material, writing with pen and paper. However, the existing research is consistent with an assumption that seems to underlie native speakers’ intuitions about *kūsho* and their actual writing practices, that is, the assumption that *kūsho* is an effective motor-based strategy or kinesthetic instrument that assists in the memorization and recollection of *kanji*. Kess and Miyamoto (1999, p. 79) articulate this assumption in asserting that *kūsho* “serves as a probe which accesses motoric- and action-based representation, as well as serving as a mnemonic device to facilitate a conscious mental process”.

## 2. *Kūsho* in second language learning

Recent research has investigated the role of *kūsho* in the orthographic practices of second language (L2) learners of Japanese. In a first, exploratory, study Thomas (2013) observed that adult L2 learners captured on video—both learners whose L1 orthography is logographic and learners whose L1 orthography is non-logographic—spontaneously executed *kūsho* while learning complex, novel,

*kanji* or while recalling previously-learned *kanji* cued by meaning or sound, and especially when cued by shape. Of 44 L2 learners who were living in Japan, all 44 employed *kūsho* at some point in the study without any explicit prompting to do so. Some learners employed it prolifically.

In a follow-up study, Thomas (forthcoming) compared the accuracy with which an additional 75 adult L2 learners (of 22 different L1 backgrounds, all resident in Japan) memorized the shapes of complex, novel, *kanji* under three different learning conditions. Participants were allowed 2.5 minutes to memorize each of three sets of three *kanji*, presented on index cards. They employed a different technique of learning in each trial. In one trial, learners were supplied with paper and pencil and directed to memorize the shapes of the target *kanji* by iterative copying. In another trial, they used visual inspection alone, merely looking at the target *kanji* with their hands restrained. In the remaining trial, they were directed to make free use of *kūsho* as a learning strategy, without access to paper and pencil. The order of presentation of the learning conditions was randomized, as was the association of *kanji* sets to learning condition. Each trial was followed by a short oral interview, then by a recall task in which participants wrote down the three target *kanji* they had just memorized, to whatever extent possible.

The participants' written output was later masked with respect to learning condition and evaluated for accuracy on a 0 to 10 scale by two independent judges, using a metric derived from that used by Onose (1987) and Hatta, Kawakami, and Tamaoka (1998). Inter-rater reliability proved very high (Cronbach's alpha = .99). Accuracy of recall of the target *kanji* proved to be highest when L2 learners employed *kūsho*, as opposed to paper-and-pencil copying or visual inspection. This is a surprising result, granted that iterative copying is the traditional, long-established, technique for memorizing the shapes of *kanji* (Kusumi 1992; Bourke, 1996, p. 35 and references cited there). The advantage attributable to *kūsho* is small but statistically significant: the mean rate of accuracy of reproduction of novel *kanji* under the copying condition was 76.67% (on average, 23.00 out of a total possible accuracy score of 30); for visual inspection, 80% (24.00/30); for *kūsho*, 85.38% (25.01/30). In a mixed effects analysis (which, as a conservative measure, retained a term for rater in the model despite the high inter-rater reliability), the difference between copying and *kūsho* proved to be statistically significant: mean difference = -1.79; SE = .7506;  $t(df) = -2.38(74)$ ;  $p = 0.018$ . In other words, when learners tried to memorize complex, novel, *kanji* using *kūsho* as a technique of learning in this experimental context, their performance was, on average, a little bit better compared to their performance when they used iterative writing. The boost in performance conferred by *kūsho* is not large, but it is statistically robust, and unexpected. Moreover, 6 of the 75 L2 learners displayed an apparently irrepressible preference for *kūsho* in that they unconsciously introduced *kūsho* into trials where they had been instructed to learn *kanji* under either the iterative copying or the visual inspection condition.

The findings of these two studies lead to three provisional conclusions about air writing in L2 learning. First, adult L2 learners do employ *kūsho* when learning new *kanji* and when recalling already-learned *kanji*, since every one of the 119 L2 learners who participated in one or the other of these two studies exhibited *kūsho* in at least one context. Second, L2 learners’ use of *kūsho* is variable: some did so during one kind of task but not another; other learners did so across the board; and for at least some learners—6 out of 75 in Thomas (forthcoming)—*kūsho* is so compelling as a technique for learning and recall that they cannot repress it. Moreover, for some learners *kūsho* is a small, unobtrusive gesture, while others employed lavish, vigorously executed, movements of the hands and arms. Some learners glanced at their hands periodically, while others seemed to consistently turn the eyes away from the *kūsho*-producing hand. Third, most L2 learners seemed to feel that *kūsho* facilitates acquisition of the orthography of Japanese: in post-test de-briefing, participants in both studies overwhelmingly expressed that they preferred to have the freedom to employ *kūsho* at will, and found it onerous to learn *kanji* with their hands restrained—even though few of these L2 learners indicated any prior awareness of their use of *kūsho*, and no one claimed to have been explicitly taught it as an instrument for learning or recall.<sup>5</sup> The advantage attributable to *kūsho* is small, but statistically significant. It is consistent with other empirical results to date, which show that access to *kūsho* facilitates native speakers’ performances in diverse *kanji* manipulation tasks (see discussion above of work by: Endo, 1988; Haga, 2009; Matsuo *et al.*, 2003; Sasaki, 1983, 1987; and Sasaki and Watanabe, 1983).

### 3. *Kūsho*, gesture, and memory

Research on *kūsho* to date is sparse, and for the most part has been descriptive rather than oriented toward theoretical debates in psycholinguistics. Nevertheless, it is possible to connect the findings summarized above, both those deriving from study of L2 learners and those from the earlier stream of work initiated by Sasaki (1984), to on-going theorizing about the role of manual gesture in cognition. For example, the small but statistically significant boost in the accuracy of recall of *kanji* that *kūsho* apparently affords to learners is parallel to a small but significant advantage that spontaneous manual gestures afford in the memorization of scenes shown on video. Cook, Yip, and Goldin-Meadow (2010) asked college students to view very short, simple, video clips, then to recall and narrate the contents of the clips verbally, both immediately and after a three-week delay. Participants who were instructed to gesture freely as they described the videos recalled more of the content of the clips than those asked not to move their hands during the description task. Cook *et al.* (2010, p. 472) conclude that “the motor encoding involved in

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<sup>5</sup> Rarely, an L2 learner declared in post-test debriefing that he or she experienced *kūsho* as conferring no particular advantage in learning and recall of *kanji*, and expressed skepticism that he or she used *kūsho*. However, this claim was always at odds with learners’ actual performance: examination of the video files showed that every participant in both studies evinced some use of *kūsho*.

gesturing is particularly efficient for encoding information into memory and retrieving that information from memory.” Wesp, Hesse, Keutmann, and Wheaton (2001) reviewed studies of gesture and memory for static visual images, finding support for their assertion that manual gestures maintain or refresh spatial images in a kind of “visuospatial scratchpad” (p. 592), thus facilitating their recall. In an earlier study that looked at recall of words rather than images or video clips, Frick-Horbury and Guttentag (1998) compared lexical retrieval with and without access to gesture. They reported that restricting gesture reduces the success of lexical retrieval.

Taken together, this research represents an emerging consensus that gestures play an important role in encoding and retrieving words, static images, and actions. *Kanji* are at once both words and complex visual images; moreover, their construction entails performing a specified sequence of actions. In this sense, existing research on gesture provides a theoretical basis for predicting that air writing should enhance recollection of *kanji*—which is, in fact, the result that emerges from the preliminary studies summarized in this article. What further analysis of the effects of *kūsho* may eventually contribute to research on gesture and cognition is some understanding of why the free, improvised, gestures that comprise *kūsho* seem to be more effective in enhancing recall of *kanji* than material copying of *kanji* on paper. Material copying certainly also involves movements of the hands, albeit more controlled and conventionalized movements. Manual gestures accompanying speech, the effects of which Cook *et al.* (2010), Wesp *et al.* (2001), and Frick-Horbury and Guttentag (1998) have examined, more closely resemble the informality and improvisational nature of *kūsho* than they resemble the deliberate, constrained, movements entailed in copying *kanji* with pen and paper, the sequence and structure of which is the target of explicit instruction to both native and non-native learners of Japanese. It remains to be seen how the formal, prescribed, manual movements entailed in material writing fit into the analysis of gesture and cognition.

#### **4. *Kūsho* in L2 pedagogy**

If on the basis of Thomas (2103) we can assume that L2 learners of Japanese do freely adopt *kūsho* into their writing practices, and moreover accept that, consonant with learners’ subjective experience, *kūsho* assists in the recall of *kanji* (Thomas, forthcoming)—then these findings raise the question of whether L2 pedagogy might capitalize on *kūsho* to ease the heavy burden of L2 acquisition of Japanese orthography. On what grounds might such a pedagogy be built, and what might it look like?

##### **4.1. Dearth of pedagogical research on *kūsho***

Potential applications of *kūsho* in L2 pedagogy remain unexplored at present. A first reason for this is that, perhaps due to the very ordinariness and ubiquity of *kūsho*, literature on the orthography of Japanese rarely acknowledges its existence.

Descriptions of the modern writing system by western-oriented scholars (for whom *kūsho* might be expected to stand out as especially salient and worth commentary) such as those by Miller (1986), Smith (1996), Erbaugh (2002), or Unger (2004), do not advert to air writing. Analyses of the history of writing in Japan, such as those by Habein (1984), Seeley (1991) or Twine (1991), likewise do not mention *kūsho*.

Moreover, *kūsho* plays virtually no role in the abundant literature directed at L2 teachers and learners of Japanese. This is true for texts directed at L2 learners of the writing system such as, *inter alia*, Ashworth and Hitosugi (1993), Bowring and Laurie (1992), Chaplin and Martin (1969), Heisig (2007–8), and Sakade (2003). It is also true of many publications directed at teachers of Japanese, including those that discuss the status of *kanji* in L2 acquisition (Ezaki, 2010; Mori, 2012); learners’ strategies for acquiring *kanji* (Douglas, 1992; Koda, 2001; Okita, 1997; Toyoda, 2009); or techniques for teaching *kanji* (Haththotuwa Gamage, 2003; Shimizu & Green, 2002; Toyoda, 1998). Writing for teachers, Richmond (2005) reviewed pedagogical texts addressed to L2 learners of *kanji*, but nowhere acknowledged *kūsho*. Nor is there evidence from a learner’s first-hand reflection on her own acquisition of the language (Leung, 2002) that she recognized *kūsho* as a resource in her efforts to master *kanji*—despite the fact that this writer was likely familiar with “finger tracing” as used by native speakers of Chinese, since Chinese was her L1.

At one step removed from the classroom context, there is commentary on the acquisition of the Japanese writing system directed at educators and educational researchers that does occasionally refer to *kūsho*. Nevertheless, there is little evidence of uptake of those references. For example, a review by Kojima *et al.* (1988)—published in English—of Japanese advances in education and psychology in the 1980s called attention to several of the early studies of *kūsho* discussed above (e.g., Sasaki, 1984, 1987; Sasaki & Watanabe, 1983, 1984) and reflected on their implications. The review quotes Sasaki’s inference on the basis of his study of *kūsho* that *kanji* “are stored in memory in the form of partially motoric representations”. Kojima *et al.* conclude their discussion expansively by asserting that *kūsho* may be “of great theoretical importance for the origin of human cognition and for the problem of culture and cognition” (p. 117). But their insight apparently went unnoticed, since the meager two citations of Kojima *et al.* (1988) identified by Google Scholar draw on other passages in their text, not the part that addresses *kūsho*.

#### **4.2. Limited conceptualization of *kūsho* in the existing pedagogical research**

Furthermore, even among studies of teaching and learning that do, exceptionally, acknowledge *kūsho* as part of Japanese orthographic practice, its potential contributions to L2 pedagogy are unexploited, for at least two reasons. One reason is that *kūsho* is rarely conceptualized as distinguishable from conventional writing in any important way. Naka and Naoi (1995), for example, discuss a series of

experiments assessing the role of repeated writing as a motor strategy in the recall of words and graphic designs. They advert to *kūsho*, but seem to tacitly conflate repeated (material) copying with pen and paper with the non-material practice of *kūsho*, as if they were psycholinguistically equivalent. Nozaki, Ejima, Umeda, and Tanaka (2012, pp. 49–50) similarly conflate conventional writing with air writing when, curiously, they cite Sasaki and Watanabe’s (1983) research on *kūsho* to promote the advantages of using a digital pen while learning *kanji*, as if *kūsho* were simply a variant form of writing. Flaherty and Noguchi (1998, p. 62) mention *kūsho* in passing as a technique used in early Japanese elementary education, in their exposition of the “Whole-*kanji*” instructional method as opposed to the “Component Analysis” method. However, Flaherty and Noguchi do so without calling attention to any distinction that might exist between using *kūsho* versus using conventional paper-and-pencil writing to learn characters as whole units. Although Flaherty and Noguchi do not raise the point, *kūsho* might equally well be employed in the Component Analysis method as in the Whole-*kanji* method; in either case, *kūsho* may differ from conventional writing in its consequences for learning, as it does in its neurolinguistic basis (Matsuo *et al.*, 2003).

There is a second way in which even literature that brings *kūsho* to light in a pedagogical context fails to appreciate its potential. Bourke’s (1996) dissertation on strategies for teaching and learning *kanji* directly addresses *kūsho*, and she does not treat it as a variant form of writing.<sup>6</sup> However, her approach still ends up missing the full scope of what *kūsho* entails. In a perceptive ethnographic analysis of a Japanese native-speaker classroom, Bourke narrates the use of *kūsho* as a technique for choral practice of stroke order (p. 170). She then considers the appropriateness of adopting “the strategy of writing in the air with large strokes and saying the stroke order aloud” in adult L2 classrooms. She speculates that this practice “may be embarrassing for adult learners” (p. 193), but leaves it open as an option for teachers who want to emphasize correct stroke order. Disappointingly, Bourke seems to perceive *kūsho* only as a technique for teacher-led classroom instruction, not (also) as a motor-based mnemonic device available to learners for use in private *kanji* learning and recall—even though these practices are abundantly and publically attested among both native speakers and L2 learners and, since the publication of Sasaki and Watanabe (1983), they have been studied by the modest body of research summarized above.

Like Bourke (1996), Flaherty (1991) acknowledges only a very limited role for *kūsho* in L2 acquisition of Japanese orthography. Flaherty analyzes the results of a questionnaire presented to adult L2 learners about strategies for the acquisition of *kanji*, then compares those data to practices used in L1 elementary education. In concluding the article with a list of recommendations, Flaherty takes a more accepting stance toward *kūsho* in L2 pedagogy than does Bourke; however,

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<sup>6</sup> Incidentally, Bourke (and also Gottlieb, 2000, p. 102) uses the term “*karagaki*” (空書き “empty writing”) to refer to what is otherwise labeled “*kūsho*”.

she still does not seem to imagine that air writing might have a place in the L2 learning of *kanji* outside classroom instruction. Flaherty suggests that L2 teachers “[w]rite characters in space” (p. 193) as one of several classroom techniques for teaching *kanji*, citing both Sasaki (1987) and neurolinguistic research showing that writers of Chinese exhibit more right-hemispheric activity than writers of English. Flaherty implies that L2 learners might mimic their teachers’ movements as a “graphomotor coding strategy” (p. 193). But she does not consider any role for *kūsho* in individual learners’ practice outside of class, nor as an aid to recall already-learned *kanji*.

#### **4.3. Problems facing conceptualization of an L2 pedagogy that incorporates *kūsho***

On the basis of this review of literature on *kanji* and the L2 pedagogy of *kanji*, it is fair to say that *kūsho* has not, to date, been explored in-depth as a technique to assist L2 learners in their efforts to master the complex orthography of Japanese. This is understandable, since most publications on the acquisition of *kanji* ignore *kūsho*, and I have argued above that even research that does acknowledge air writing views it in conceptually impoverished terms. But to go beyond these limits to invent a formal pedagogy of L2 Japanese that exploits the full potential of *kūsho* would require facing up to at least three foreseeable problems.

First, there is the question of whether an improvised, unconscious or semi-conscious mnemonic practice (as observed in Thomas, 2013) would retain its apparent efficacy if learners were to deliberately harness it as an instrument for learning or recall. Thomas (forthcoming) explicitly directed learners’ attention to *kūsho*, then recruited their self-conscious application of it to the task of learning complex, novel *kanji*. The results suggested that *kūsho* did indeed result in more accurate recall than visual inspection or writing. This result implies that *kūsho* is neither so ineffable, nor so subliminal to awareness, that learners cannot willfully, and successfully, apply it to the task of learning *kanji*. But further research is required to discover whether there is any substantial distortion introduced when learners apply air writing as a self-conscious tool for learning, compared to air writing that springs up spontaneously in the course of memorizing and recalling *kanji*.

A second problem is that the key finding of Thomas (forthcoming)—the association of *kūsho* with higher rate of accuracy as a learning condition, a difference that was small but statistically significant compared to either mere visual inspection or iterative paper-and-pencil copying—is based on experimental conditions that test short-term memory. Mastery of the Japanese orthographic system demands rich, deep, and dynamic knowledge of *kanji*, and ease in accessing not only thousands of *kanji* through meaning, sound, and form, but also the network of their combinatorial privileges. The sustained investment in time and effort required to build up these skills cannot be replicated realistically in a laboratory context, so that on the basis of experimental data, one can only make

inferences about the potential contribution of *kūsho* to real-world control over the Japanese orthographic system.

Those inferences are not unwarranted, granted native and non-native speakers' robust voluntary investment in *kūsho*. Still, ideally one would want to see evidence for the efficacy of *kūsho* based on longitudinal data that compared the accuracy of long-term recall of *kanji* learned with *kūsho*, versus *kanji* learned without *kūsho*. Such a study would face challenging problems of research design: for example, it would have to ensure that participants fully suppressed *kūsho* in the acquisition and recall of certain characters, while fully employing *kūsho* (or at least employing *kūsho* at will) in the acquisition and recall of other characters—and that this differential treatment was sustained for some substantial interval.

A third impediment to developing a pedagogy that exploits *kūsho* concerns the understanding that L2 learners differ in their preferences for sensory involvement in language acquisition (Dörnyei, 2005; Reid, 1998). On the basis of research into sensory style variation among L2 learners, we would expect that some would find the kinesthetic stimulation that *kūsho* affords very rewarding, while others might profit less from it or might even consider it “embarrassing”, as Bourke (1996, p. 193) assumed would be the general response<sup>7</sup>. Research into learners' sensory styles (conventionally analyzed as either visual, auditory, or kinesthetic) has not advanced far enough to predict how formative these propensities are, or how to match sensory styles to pedagogical practices, or how learners adapt to a mismatch between their own sensory style and a particular pedagogy. However, one might anticipate *kūsho* to be differentially effective as a learning strategy across a normally heterogeneous population of learners, a factor that complicates interpretation of measures of its overall apparent influence on learning.

#### **4.4. What might an L2 pedagogy that capitalized on *kūsho* look like?**

Imagine that research could be designed to satisfy these reservations, and further imagine that its outcome strengthened the contingent finding to date, namely, that *kūsho* does indeed provide a useful kinesthetic stimulus to memorization and recall of Japanese characters. How then might air writing be incorporated into L2 pedagogy?

As a supplement to the array of strategies already used for L2 instruction in the Japanese orthographic system (reviewed by Bourke, 1996; Hatthothuwa Gamage, 2003; Shimizu & Green, 2002; Toyoda, 1998), *kūsho* has striking advantages. First, it is highly undemanding of resources, with no obvious commercial dimension: no materials need to be assembled, no equipment purchased, no complex training imposed on teachers—and since *kūsho* seems to

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<sup>7</sup> I would add, however, that none of the 119 learners I worked with evinced any “embarrassment” or inhibition about *kūsho*, although many seemed surprised or amused by my interest in it. Most seemed to consider *kūsho* so obvious and natural a practice as to not warrant attention.

have such inherent appeal to learners that they adopt it spontaneously (or, as some learners believe, invent it independently), essentially no training need be imposed on learners as well. Adding *kūsho* as an adjunct to L2 pedagogy might entail only something as simple as a teacher’s casual and repeated demonstration of air writing in the classroom, followed by an acknowledgement of its value, and encouragement to students to employ *kūsho* at will. A teacher might point out that students can use *kūsho* not only in a classroom setting where, as beginners, they are focused on acquiring the general principles of stroke order, but also in private study as a way to build into their hands kinesthetic familiarity with the shapes of *kanji* at the same time as they are using their eyes to build up visual representations of *kanji* and to associate those visual representations with sounds and with meanings. Teachers might also suggest that, when students are stymied trying to recall a specific *kanji*, they employ *kūsho* to write in the air whatever portion of the character they can recall, as a probe that may prime their memory of its totality. Moreover, teachers could call attention to any instances of “conversational *kūsho*” which they may observe in video materials included in the curriculum, or which emerge in conversations between native speakers that take place in the classroom, asking students to speculate about the functions of air writing in oral communication in that specific context.

A second advantage of *kūsho* is that it is very flexible, and can be employed in circumstances where practice writing *kanji* with paper and pencil would be awkward. In the special case of students living in Japan, habitual practice of *kūsho* may help a learner move beyond passive recognition to more active productive control over the shapes of *kanji* observed in the environment. Moreover, the practice itself can be adapted to whatever feels appropriate or comfortable to learners: slow or fast; small, subtle, and hidden from view, or large, demonstrative, and conspicuous. Another facet of the flexibility of *kūsho* lies in the fact that it could be inconspicuously adopted into any approach to teaching or learning *kanji* without distorting the special emphasis of that approach. That is to say, learners taught to decompose characters into their components could use *kūsho* as a mnemonic device equally as could learners taught to grasp characters as whole configurational units, or learners whose approach emphasizes phonetic cues.

A third advantage of *kūsho* derives from a possibly unique role it might play in the twenty-first century educational context where, for both native and non-native learners, traditional manual writing is being replaced by writing with computer support.

### **5. *Kūsho* and the keyboard**

Gottlieb (2000, 2005) provides a searching and provocative discussion of the effects of adoption of character-based word-processing technology in Japan, which have influenced Japanese culture on many levels: political, economic, social, educational, literary, and in popular culture. Of greatest relevance here is the often-discussed claim (DeFrancis, 1989; Gottlieb, 2000; 2005; Kess &

Miyamoto, 2001) that as more and more people literate in Japanese become acclimated to writing the language with computer support, their control over the *kanji*-based orthography of Japanese will erode, for a number of reasons. One reason is that as writers become facile with writing Japanese through word-processing technology, they come to rely on an electronic bank of sound-meaning correspondences rather than their own memories. In discussing this phenomenon, Kess and Miyamoto (2001) develop the notion that the basis of literacy in Japanese is bifurcating into *kanji* that one can only read but not write, and those that one can (read and) write. Gottlieb (2000) cites a 1992 survey of 687 experienced native-speaker writers, 48% of whom reported “that they had indeed begun to forget characters since they had begun to use a word processor” (p. 96); the study went on to document that for Japanese college students, length of experience writing with a word processor correlated with greater sense of loss of competence with *kanji*.

In the years since 1992, taken as a date significant to the spread of word-processing technology in Japan, it has become axiomatic that Japanese speakers’ capacity to recall *kanji* quickly and accurately has declined (Gottlieb, 2005). In addition to the evidence that computer use erodes the ability to retrieve *kanji*, there is abundant anecdotal evidence that replacing a pen with a keyboard threatens the highly articulated fine motor skills required to physically inscribe *kanji*. If reliance on a keyboard eventually compromises one’s motor skills, that loss of productive competence may further increase one’s reliance on a keyboard, creating a loop of mounting dependence on electronic support for the simple act of writing (Kess & Miyamoto, 2001, p. 181).

Although I know of no empirical research that has substantiated the often-expressed claim that computer use leads to deterioration of the motor skills underlying handwriting, some links in this hypothetical chain of events are, in fact, supported by research findings. For example, there is evidence that writing by hand matters when it comes to recall. Cunningham and Stanovich (1990), for example, showed that children learning to write in L1 English score significantly higher on spelling tests when they practice the target words by writing rather than by typing. Kaiho and Saito (1989) analyzed Japanese students’ reading and writing skills in an attempt to understand what made some *kanji* more “familiar” than others—that is, more accurately recalled on presentation of their associated readings. They concluded that the “familiarity” of a particular *kanji* correlated more with a student’s ability to write it longhand than it correlated with the character’s frequency in the input or the variety of compounds in which it appears. Gottlieb (2000) cited a television program broadcast on NHK (Japan Broadcasting Corporation) that reviewed a study in which 40 Japanese children were assigned to learn new characters by using a word processor versus via iterative writing. In a later dictation test, 75% of the writing group, but no one in the word-processing group, received a perfect score.

The same NHK program went on to probe what makes writing by hand matter, in a study consistent with some of the earlier research on *kūsho*. The researchers first asked native speakers of Japanese to try to identify *kanji* described orally, component by component, and observed participants executing *kūsho* in their laps. When the researchers repeated the experiment while restraining the participants’ hands, they were then unable to identify the target *kanji*. Gottlieb (2000) concluded that “...it is clear that handwriting, the learned sequence of hand movements which results in production of the character, plays a significant role in recall” (p. 102).

Gottlieb’s comment conceptualizes participants’ greater capacity to identify *kanji* in the first part of the study as evidence for the value of handwriting. But note that what was actually being tested here was not handwriting *per se* but participants’ ability to integrate and identify a character with, versus without, access to *kūsho* (which of courses shares a kinesthetic basis with handwriting but, I would argue, is not identical to it). Nevertheless, Gottlieb’s point still stands: facility with *kanji* is linked to motor skills. If word-processing supplants handwriting, erosion of motor skills may be one of the effects of that shift, and simultaneously, one of the reasons why the shift takes place.

This returns the discussion to a third plausible advantage of an L2 pedagogy that sanctions the practice of *kūsho*. In interview data gathered in the course of Thomas (forthcoming), I asked L2 learners to describe their experience with writing in Japanese with electronic support. Every one of 75 participants claimed to have at least some facility with writing Japanese on a keyboard: some claimed to do so only for specific tasks (e.g., sending text messages) while for others, especially more advanced learners, keyboard-based writing had thoroughly eclipsed handwriting.<sup>8</sup> These learners are in the vanguard, but clearly keyboard-based writing is spreading quickly in L2 classrooms. Writing Japanese with computer assistance certainly has advantages for learners (Chikamatsu 2003; Dixon 2010). But one disadvantage shared with native speakers is that use of a keyboard likely erodes both motor skills and facility retrieving *kanji*, with each of these effects likely enlarging the other. However, we have reviewed research suggesting that *kūsho* is an effective and ecologically sound device for memorizing and recalling *kanji*. The flexibility and dynamism of *kūsho* make it imaginable that writers could incorporate it into practices of keyboard-based writing in contexts where conventional writing might be intrusive. For example, learners might be trained to stimulate their kinesthetic control over *kanji* they have successfully searched for in an electronically supplied drop-down menu, by writing them in the air (in part, or in whole) once they had been retrieved. To suspend the stream of a writer’s cognitive and physical acts entailed in

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<sup>8</sup> Learners in the latter group often described a practice that revealed an intriguing inversion of the traditional relationship between handwriting and typewriting: faced with an assignment that had to be submitted in longhand, they would compose the text with *kana* and *kanji* on a word-processor, and then reproduce that mechanically-produced text by hand to create the final draft.

composition *in media res* to pick up a pen and inscribe a freshly-retrieved *kanji* on paper might constitute too much of an interruption, while tracing the shape of the character in the air may be more tolerable to learners.

With the development of tablet personal computers equipped with online handwriting-recognition software designed for writers of Japanese and Chinese, scholars and teachers are searching for a way to combine computer-based character recognition capacity with the acknowledged advantages of motor training, which has long been the basis of literacy in “*kanji-culture*” orthographies. Research has begun that aims to assess the educational value of tablet PCs with *kanji* recognition software, which dispenses with a keyboard (Iwayama *et al.*, 2004; Li & Akahori, 2007; Tsai, Kuo, Horng, & Chen, 2012). These developments in educational technology are promising, even if research results to date are mixed. There is more focus on native speakers than on L2 learners, and no such study has compared the effects of *kanji* practice on a tablet PC with the decidedly low-tech practice of air writing. Moreover, there are many factors to consider: although writing on a tablet PC with a bare fingertip might closely mimic the movements entailed in the production of *kūsho*, using the tablet in a conventional manner would result in a visible output, and in this way mimic conventional writing practice. Research into the educational applications of tablet PCs for L2 learners might eventually tease apart the roles of motor training and visual input to learners of *kanji*, opening up new insight into the status of *kūsho* as an adjunct to acquisition of the orthographic system of Japanese.

## 6. Conclusion

This article brings attention to a facet of Japanese literacy that has been little discussed, but which deserves a closer look as a device that supports learners’ efforts to master a complex orthography. I review existing research showing that air writing facilitates *kanji* recall and processing among native speakers of Japanese, and introduce two studies suggesting that it is an effective technique for enhancing L2 learners’ memorization of novel, complex *kanji* relative to either mere visual inspection or conventional iterative copying.

A review of the literature on teaching and learning *kanji* indicates that *kūsho* plays little role at present in L2 pedagogy. There are various reasons for this, including the fact that there has not been full enough conceptualization of the distinction between *kūsho* and paper-and-pencil copying of characters despite their different psycholinguistic status; and the failure of researchers and teachers to recognize the availability of *kūsho* as a resource for private practice during memorization and recall (as opposed to its use in publically demonstrating stroke order conventions). Creating a pedagogy for L2 learners of Japanese that capitalizes on the flexibility and natural appeal of air writing is a task that remains to be carried out. A full assessment of the potential of *kūsho* as an adjunct learning practice in L2 acquisition of the orthography of Japanese is only in its infancy. But

the educational, psycholinguistic, and cultural ramifications of air writing warrant greater scrutiny.

## References

- Ashworth, D. E., & Hitosugi, I. (1993). *Written Japanese: An introduction*. Honolulu, HI: Japan-America Institute of Management Science.
- Bourke, B. (1996). *Maximizing efficiency in the kanji learning task* (Unpublished doctoral dissertation). The University of Queensland, Australia.
- Bowring, R. B., & Laurie, H. U. (1992). *An introduction to modern Japanese*. Cambridge, UK: Cambridge University Press.
- Chaplin, H. I., & Martin, S. E. (1969). *A manual of Japanese writing*. New Haven, CT: Yale University Press.
- Chikamatsu, N. (2003). The effects of computer use on L2 Japanese writing. *Foreign Language Annals*, 36(1), 114–127.
- Cibulka, P. (2013). The writing hand: Some interactional workings of writing gestures in Japanese conversation. *Gesture*, 13(2), 166–192.
- Cook, S.W., Yip, T.K., & Goldin-Meadow, S. (2010). Gesturing makes memories that last. *Journal of Memory and Language* 63(4), 465–475.
- Cunningham, A. E., & Stanovich, K. E. (1990). Early spelling acquisition: Writing beats the computer. *Journal of Educational Psychology*, 82(1), 159–162.
- DeFrancis, F. (1989). *Visible language: The diverse oneness of writing systems*. Honolulu, HI: University of Hawai'i Press.
- Dixon, M. (2010). The effects of computer-assisted text input in early JFL learning. *Proceedings of the 22nd Annual Conference of the Central Association of Teachers of Japanese*, Purdue University, 30–43.
- Dörnyei, Z. (2005). *The psychology of the language learner: Individual differences in second language acquisition*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Douglas, M. O. (1992). *Development of orthography-related reading/writing strategies by learners of Japanese as a foreign language* (Unpublished doctoral dissertation). University of Illinois at Champaign-Urbana, IL.
- Endo, Y. (1988). The role of a motoric aspect of representation: Spontaneous writing-like behavior in Japanese. In M. M. Gruneberg, P. E. Morris, & R. N. Sykes (Eds.), *Practical aspects of memory: Current research and issues. Vol. 2. Clinical and educational implications* (pp. 459–463). Chichester, UK: John Wiley and Sons.
- Erbaugh, M. S. (Ed.). (2002). *Difficult characters: Interdisciplinary studies of Chinese and Japanese writing*. Columbus, OH: The Ohio State University.
- Ezaki, M. (2010). Strategic deviations: The role of *kanji* in contemporary Japanese. *Japanese Language and Literature*, 44(2), 179–212.
- Flaherty, M. (1991). Do second-language learners of Japanese process *kanji* in the same way as Japanese children? *Sekai no Nihongo Kyoiku* [Japanese Language Education around the Globe], 1(March), 183–200.
- Flaherty, M., & Noguchi, M. S. (1998). Effectiveness of different approaches to *kanji* education with second language learners. *JALT Journal*, 20(2), 60–78.
- Frick-Horbury, D. & Guttentag, R.E. (1998). The effects of restricting hand gesture production on lexical retrieval and free recall. *The American Journal of Psychology*, 111(1), 43–62.

- Gottlieb, N. (2000). *Word-processing technology in Japan: Kanji and the keyboard*. London, UK: Routledge.
- Gottlieb, N. (2005). *Language and society in Japan*. Cambridge, UK: Cambridge University Press.
- Habein, Y. S. (1984). *The history of the Japanese written language*. Tokyo: University of Tokyo Press.
- Haga, Y. (2009). Kanji kakusuu kaunto bamen ni okeru 'kūsho' kōdō no bunseki [Analysis of *kūsho* behavior in a *kanji*-stroke-counting task]. *Kokoro to Kotoba* [Mind and Language], 8, 75–83.
- Haththotuwa Gamage, G. (2003). Issues in strategy classifications in language learning: A framework for *kanji* learning in strategy research. University of Wollongong Research Online: <http://ro.uow.edu.au/artspapers/68>
- Hatta, T., Kawakami, A., & Tamaoka, K. (1998). Writing errors in Japanese *kanji*: A study with Japanese students and foreign learners of Japanese. *Reading and Writing: An Interdisciplinary Journal*, 10(3–5), 457–470.
- Heisig, J.W. (2007–8). *Remembering the kanji: A complete course on how not to forget the meaning and writing of Japanese characters*, Vol. 1 (4th ed.); Vol. 2 (3rd ed.); Vol. 3 (2nd ed., with Introduction by T. Sienko). Honolulu, HI: University of Hawai'i Press.
- Hoosain, R. (1991). *Psycholinguistic implications for linguistic relativity: A case study of Chinese*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Iwayama, N., Akiyama, K., Tanaka, H., Tamura, H., & Ishigaki, K. (2004, October). Handwriting-based learning materials on a tablet PC: A prototype and its practical studies in an elementary school. In *Frontiers in Handwriting Recognition, 2004. IWFHR-9 2004: Ninth International Workshop on Frontiers in Handwriting Recognition*, (pp. 533–538). IEEE Computer Society.
- Kaiho, H., & Saito, H. (1989). Measuring various aspects of *kanji* (Chinese characters) and its [*sic*] psychological implications. *Japanese Quantitative Linguistics*, 39, 151–163.
- Kess, J. F., & Miyamoto, T. (1999). *The Japanese mental lexicon: Psycholinguistic studies of kana and kanji processing*. Philadelphia/Amsterdam: John Benjamins.
- Kess, J. F., & Miyamoto, T. (2001). *Kanji* knowledge as read-only vs. write-only: The effect of the computer age? In M. Nakamura (Ed.), *Japan in the global age* (pp. 175–184). Vancouver, BC: University of British Columbia.
- Koda, K. (2001). Development of *kanji* knowledge among adult JFL learners. In H. Nara (Ed.), *Advances in Japanese language pedagogy* (pp. 1–29). Columbus, OH: The Ohio State University.
- Kojima, H., Hayamizu, T., Aoi, N., Yoshizaki, K., & Hiraishi, K. (1988). Trends in educational psychology in Japan. *The Annual Report of Educational Psychology in Japan*, 27, 116–141.
- Kusumi, T. (1992). Meta kioku [Meta-memory]. In Anzai, Y., Ishizaki, S., Otsu, Y., Hatano, G., & Mizogushi, H. (Eds.), *Ninchi kagaku handobukku* [Handbook of cognitive science] (pp. 238–250). Tokyo: Kyoritsu Shuppan.
- Leung, C. Y. (2002). Extensive reading and language learning: A diary study of a beginning learner of Japanese. *Reading in a Foreign Language*, 14(1) (n.p.).
- Li, K., & Akahori, K. (2007). The effects of handwritten feedback on paper and tablet PC in learning Japanese writing. *iJET*, 2(4), 54–60.
- Mann, V. A. (1985). A cross-linguistic perspective on the relationship between temporary memory skills and early reading ability. *Remedial and Special Education*, 6(6), 37–42.

- Matsuo, K., Kato, C., Okada, T., Moriya, T., Glover, G. H., & Nakai, T. (2003). Finger movements lighten neural loads in the recognition of ideographic characters. *Cognitive Brain Research*, 17(2), 263–272.
- Miller, R. A. (1986). *Nihongo: In defence of Japanese*. London: The Athlone Press.
- Mori, Y. (2012). Five myths about *kanji* and *kanji* learning. *Japanese Language and Literature*, 46(1), 143–169.
- Murakami, S. (1991). Kūsho ni miru hyōshō no keisei [Representation forming in *kusyo* behaviour]. *Hattatsu Shinrigaku Kenkyū* [The Japanese Journal of Developmental Psychology], 2(1), 25–31.
- Naka, M. (1998). Repeated writing facilitates children’s memory for pseudocharacters and foreign letters. *Memory and Cognition*, 26(4), 804–809.
- Naka, M., & Naoi, H. (1995). The effect of repeated writing on memory. *Memory and Cognition*, 23(2), 201–212.
- Nozaki, H., Ejima, T., Umeda, K., & Tanaka, Y. (2012). *Kanji* learning strategies: Acquisition of motor skills. *Proceedings of the International Conference on Computers in Education 2012*. Paper presented at ICCE ’12: 20th International Conference on Computers in Education, Singapore (49–52). Nanyang Technological University, Singapore: National Institute of Education.
- Okita, Y. (1997). Students’ beliefs about learning Japanese orthography: Beyond the textbooks. In H. M Cook, K. Hijirida, & M. Tahara (Eds.), *New trends and issues in teaching Japanese language and culture* (pp. 61–75). Honolulu, HI: University of Hawai’i Press.
- Onose, M. (1987). Yōji jidō ni okeru nazori oyoji shisha no renshū ga shoji ginō no shūtoku ni oyobosu kōka [The effect of tracing and copying practice on handwriting skills of Japanese letters in preschool and first grade children]. *Kyōiku Shinrigaku Kenkyū* [Japanese Journal of Educational Psychology], 35(1), 9–16.
- Reid, J. M. (Ed.). (1998). *Understanding learning styles in the second language classroom*. Upper Saddle River, NJ: Prentice Hall.
- Richmond, S. (2005). A re-evaluation of *kanji* textbooks for learners of Japanese as a second language. *Journal of the Faculty of Economics, Kyoto Gakuen University*, 15(July), 43–71.
- Sakade, F. (2003). *A guide to reading and writing Japanese* (3rd ed.). Boston, MA: Tuttle.
- Sasaki, M. (1984). Kūsho kōdō no hattatsu [A developmental study of spontaneous writing-like behavior (*‘kūsho’*) in Japanese child (*sic*)]. *Kyōiku Shinrigaku Kenkyū* [Japanese Journal of Educational Psychology], 32(1), 34–43.
- Sasaki, M. (1987). Why do Japanese write characters in space? *International Journal of Behavioral Development*, 10(2), 135–149.
- Sasaki, M., & Watanabe, A. (1983). Kūsho kōdō no shutsugen to kinō: Hyōshō no undō kankakuteki na seibun ni tsuite [An experimental study of spontaneous writinglike behaviour (*‘kūsho’*)]. *Kyōiku Shinrigaku Kenkyū* [Japanese Journal of Educational Psychology], 31(4), 273–282.
- Sasaki, M., & Watanabe, A. (1984). Kūsho kōdō no bunka-teki kigen [Cultural origin of *‘kūsho’* behaviour]. *Kyōiku Shinrigaku Kenkyū* [Japanese Journal of Educational Psychology], 32(3), 19–27.
- Seeley, C. (1991). *A history of writing in Japan*. Leiden: E. J. Brill.
- Shimizu, H. (1997). Psycholinguistic research on word identification in Japanese *kanji*: Implications for JFL pedagogy. In H. M. Cook, K. Hijirida, & M. Tahara (Eds.), *New*

- trends and issues in teaching Japanese language and culture* (pp. 45–59). Honolulu, HI: University of Hawai‘i Press.
- Shimizu, H., & Green, K. E. (2002). Japanese language educators’ strategies for and attitudes toward teaching *kanji*. *The Modern Language Journal*, 86(2), 227–241.
- Smith, J. S. (1996). Japanese writing. In P. T. Daniels & W. Bright (Eds.), *The world’s writing systems* (pp. 209–217). New York, NY: Oxford University Press.
- Sumiyoshi, C. (1996). Ei tango sōki ni mirareru kūsho kōdō [*Kūsho* behavior in remembering English spellings]. *Kyōiku Shinrigaku Kenkyū* [Japanese Journal of Educational Psychology], 44(1), 75–84.
- Thomas, M. (2013). “Air writing” and second-language learners knowledge of *kanji*. *Japanese Language and Literature*, 47(1), 23–58.
- Thomas, M. (Forthcoming). ‘Air writing’ as a technique for the acquisition of Sino-Japanese characters by second language learners.
- Thomas, M. (In preparation). ‘Air writing’ as an oral communicative strategy by native speakers of Japanese versus L2 learners.
- Toyoda, E. (1998). Teaching *kanji* by focusing on learners’ development of graphemic awareness. *Australian Review of Applied Linguistics, Series S*(15), 155–168.
- Toyoda, E. (2009). An analysis of L2 readers’ comments on *kanji* recognition. *Electronic Journal of Foreign Language Teaching*, 6(1), 5–20.
- Tsai, C.-H., Kuo, C.-H., Horng, W.-B., & Chen, C.-W. (2012). Effects on learning logographic character formation in computer-assisted handwriting instruction. *Language Learning and Technology*, 16(1), 110–130.
- Twine, N. (1991). *Language and the modern state: The reform of modern Japanese*. London: Routledge.
- Unger, J.M. (2004). *Ideogram: Chinese characters and the myth of disembodied meaning*. Honolulu, HI: University of Hawai‘i Press.
- Wesp, R., Hesse, J., Keutmann, D., & Wheaton, K. (2001). Gestures maintain spatial imagery. *The American Journal of Psychology*, 114(4), 591–600.
- Xu, Y., Chang, L.-Y., Zhang, J., & Perfetti, C. A. (2013). Reading, writing, and animation in character learning in Chinese as a foreign language. *Foreign Language Annals*, 46(3), 423–444.
- Yim-Ng, Y.-Y., Varley, R., & Andrade, J. (2000). Contribution of finger tracing to the recognition of Chinese characters. *International Journal of Language and Communication Disorders*, 35(4), 561–571.

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