



Short Communication

Expression of nonconscious knowledge via ideomotor actions

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ABSTRACT

Ideomotor actions are behaviours that are unconsciously initiated and express a thought rather than a response to a sensory stimulus. The question examined here is whether ideomotor actions can also express nonconscious knowledge. We investigated this via the use of implicit long-term semantic memory, which is not available to conscious recall. We compared accuracy of answers to yes/no questions using both volitional report and ideomotor response (Ouija board response). Results show that when participants believed they knew the answer, responses in the two modalities were similar. But when they believed they were guessing, accuracy was at chance for volitional report (50%), but significantly higher for Ouija response (65%). These results indicate that implicit semantic memory can be expressed through ideomotor actions. They also suggest that this approach can provide an interesting new methodology for studying implicit processes in cognition.

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1. Introduction

Ideomotor actions are movements or behaviours that are unconsciously initiated, usually without an accompanying sense of conscious control (Carpenter, 1852; for review see Stock & Stock, 2004). They include mimicry patterns that unconsciously result from watching—or even just imagining—another person's behaviour (Bargh & Chartrand, 1999), as well as phenomena like table turning, dowsing, and pendulum use (Wegner, 2002). Despite the wide variety of such actions, all share a common characteristic: an unawareness of the origin of the action. The Ouija game is a popular example of this. Here, a movable indicator (planchette) is placed upon a board containing the words “yes” and “no”, as well as the letters of the alphabet. Players ask a question, position their fingers on the planchette, and then follow it as it moves about the board spelling out an answer. Small hand movements are transferred to the planchette, which seems to move autonomously. Indeed, users are often convinced that one of the other players—or even a “spirit”—is moving the planchette.

Although deception and cheating in such circumstances likely exists to some extent, it may be that in many cases ideomotor actions actually express the nonconscious (or *implicit*) contents of thought. If so, a Ouija-type apparatus could be a useful technique for studying implicit cognition. This paper provides evidence for the feasibility of such an approach.

To the best of our knowledge, the nature of the information conveyed by ideomotor actions has never been carefully examined. Previous work has focused primarily on the mode of induction (i.e., the ultimate origin of the action): whether it is *external*, with people reproducing movements they see (Easton & Shor, 1975, 1976, 1977; Jastrow, 1892; Knuf, Aschersleben, & Prinz, 2001; Tucker, 1897), or *internal*, with movements reflecting what they think about (Burgess et al., 1998; Chevreul, 1833, 1854; Wegner, Ansfield, & Pilloff, 1998) or would like to see happen (Knuf et al., 2001). Subliminal

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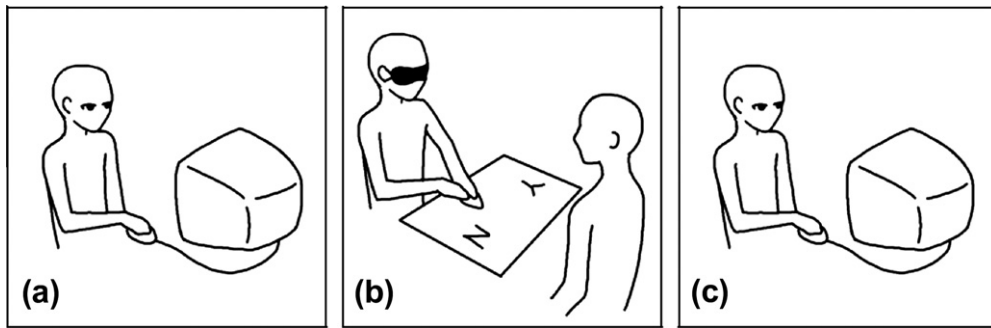


Fig. 1. Experimental phases. (a) *Pre-Ouija volitional report*: For each question (list A), participants clicked on their answer (yes/no) and then indicated their level of confidence (known/guessed). Once this task was completed a subset of eight questions (list A') was randomly extracted for use during the next phase. (b) *Ouija response*: Each participant was paired with a confederate pretending to be another participant. The experimenter asked the questions in list A', plus an additional eight questions not presented previously (list B'). The task was to wait until the planchette started moving and then to follow the movement until a yes/no answer was reached. Being blindfolded, the participant was not aware that the confederate was not touching the planchette. (c) *Post-Ouija volitional report*: Similar to the first phase, using the questions in list B' plus an additional eight questions not presented before (list B'').

priming based on stereotypes has been found to induce complex social behaviours (Chen & Bargh, 1997), supporting the idea that some ideomotor responses can express nonconscious beliefs. However, it remains unclear whether this effect is specific to social schemas and external induction, and whether the knowledge involved always remains inaccessible to consciousness. It is also unclear how general this effect is—whether it can also involve other kinds of nonconscious knowledge, and whether it can be expressed in other kinds of ideomotor actions, particularly those for which induction is internal.

In this study we examine the control of internally-induced ideomotor actions via implicit long-term semantic memory. Such memory is neither readily available to conscious recall nor to recognition (Thomson, Milliken, & Smilek, 2010; Tulving, Schacter, & Stark, 1982). The issue investigated here is whether the contents of this kind of memory can be expressed through ideomotor actions in the complete absence of conscious awareness.

To examine this possibility, we compared the answers obtained by two different types of response: volitional report and Ouija response (Fig. 1). For *volitional report* participants answered “yes” or “no” to each of a list of general knowledge questions; for each answer they also stated whether they knew it or had to guess. For *Ouija response*, participants used a planchette on a Ouija board to answer a subset of these questions with a “yes” or a “no”. Interestingly, for guessed answers the accuracy for Ouija responses was significantly higher (65%) than for volitional reports (50%, essentially chance), indicating that nonconscious knowledge can indeed be expressed through ideomotor actions.

2. Material and methods

2.1. Participants

Twenty-seven university students participated; each was compensated 20 dollars for a 2-h session. None reported having played Ouija before, nor were aware of the purpose of the experiment.

2.2. Material

Ninety-six questions were used in total. These tested general knowledge, and required yes/no answers (e.g., *Is Buenos Aires the capital of Brazil?* *Were the 2000 Summer Olympics held in Sydney?*). Questions were selected after a pilot study to yield a good balance between “known” and “guessed” answers for most people. The correct answer was yes for half the questions in each list and no for the other half.

The Ouija board was a traditional Ouija game (By Papa's toy Co. Ltd. Ouija™, a trademark of Hasbro, Inc.). This was a 34 × 29 cm cardboard rectangle marked with letters, numbers, and the words “yes” and “no” written in the left and right top corner respectively. The movable indicator (planchette) was a light triangular plastic shape mounted on three short legs. The board was placed on a table, with the planchette positioned on a starting point on the bottom edge of the board at equal distance (18 cm) from the words “yes” and “no”.

2.3. Procedure

The experiment consisted of three phases. In the first (*pre-Ouija volitional report*), participants were given a list of 80 questions (list A), with the correct answers to these equally likely to be “yes” or “no”. These were presented on a monitor, one at a time. For each question, participants clicked on their answer (yes/no) and then indicated their level of confidence (known/guessed). No feedback was given. (For the specific instructions given to participants, see Appendix.). Once this task was

completed, a subset of eight questions (list A') was randomly extracted for use during the next phase, subject only to the constraint that for each participant there was one question in each of the eight category combinations: two question polarities (correct answer is "yes"/"no") \times 2 answer confidence levels (known/guessed) \times 2 answer correctness levels (right/wrong)).

In the second phase (*Ouija response*), each participant was paired with a confederate pretending to be another participant. The participant and confederate sat at a table facing each other, with the Ouija board between them, facing the confederate. After a brief introduction about Ouija and preliminary instructions (see Appendix), the participant and confederate were asked 4–6 simple practice questions (e.g., *Is it Monday today?*). For each question the participant and the confederate placed their right and left forefingers lightly on the planchette. They waited until the planchette started moving, and then had to follow the movement without intentionally moving the planchette. If after two questions no movement was observed, the confederate would induce a movement. The goal of the practice session was to ensure that the participant experienced the planchette movement and learned where the "yes" and "no" answers were located on the board.

Once the practice session was over, a final set of instructions was given to both the participant and the confederate (see Appendix). The experimenter placed a blindfold over the eyes of the confederate and then did the same with the participant. Once the participant had been blindfolded, the confederate removed her own blindfold and pretended to continue playing Ouija for the rest of the session. (In reality the confederate never touched the planchette again; her purpose was simply to let the participant believe that he or she was not the only one in contact with the planchette.) For each trial the experimenter asked a question and then placed the participant's forefingers on the planchette, and pretended to do the same with the confederate. Sixteen questions were asked: eight which the participant had already answered during the first phase (list A'), and eight which were new (list B') and were the same for all participants. Each trial stopped once a clear answer was obtained. (This was defined as the planchette reaching the "yes" or "no" words). At no time was the confederate or experimenter in contact with the planchette—the Ouija responses were made entirely by the participant. Participants were asked to nod their head during a trial whenever they believed they were responsible for the movement of the planchette.

The third phase (*post-Ouija volitional report*) was similar to the pre-Ouija phase. Participants answered 16 questions (list B): half of these had already been presented during the Ouija phase (list B') and half had never been asked before (list B'').

3. Results

3.1. Data exclusion

Six participants were excluded from the analysis because of motor response. Two made no actions at all—despite the repeated instructions to place their fingers lightly on the planchette, they placed too much pressure on it to allow any movement. For two others, the planchette moved only along the median line between "yes" and "no", with no clear trends observed for any question. One participant had a strong and fast Ouija movement, but this movement (and subsequent answer) was the same in all trials. Finally, one participant guessed that the planchette trajectory could be influenced by his conscious thoughts and spent most of each trial focusing on the direction of the movement; it was the only time we observed directional changes during the planchette movement.

3.2. Ideomotor response and subjective experience

The planchette always followed a linear or curvilinear trajectory. The beginning of a movement always aligned with its global direction—once launched, no directional changes were observed except for the one participant noted above (Section 3.1). Five participants (two once and three twice) indicated that they felt responsible for the movement: during their debriefing, they explained they felt a muscle spasm (due to fatigue) jolt the planchette. All participants reported that they were only following the movement—they never induced it. When told that they were the only player moving the planchette during the Ouija session, all exhibited some degree of surprise. Indeed, several reported that they suspected the other participant to be a confederate because the planchette was moving too well, and they assumed that her role was to move it intentionally.

3.3. Analysis of behaviour

All analysis was based on the responses to the questions in lists A' and B'. These were exactly those questions to which both volitional reports and Ouija responses had been made.

3.3.1. Accuracy

Mean accuracies were assessed as a function of response modality (volitional report/Ouija response) and answer confidence (known/guessed) (Fig. 2). Two-way repeated-measures two-tailed ANOVA ($N = 21$) showed no significant effect of modality ($F(1,20) = 1.7$, $p = .207$) or confidence ($F(1,20) = 3.24$, $p = .087$).

Interestingly, there was a significant interaction between modality and confidence ($F(1,20) = 22.95$, $p < .001$): the difference in accuracy between Ouija response and volitional report was stronger for guessed (15%) than for known answers

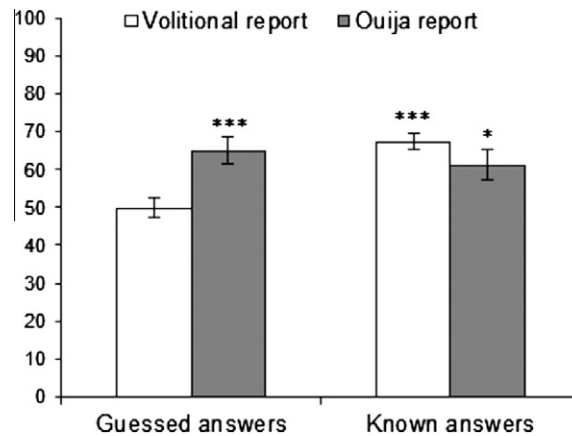


Fig. 2. Accuracy as a function of confidence level (guessed/known answers) and response modality (Volitional/Ouija report). Error bars denote the standard error of the mean associated with each condition. Asterisks indicate significant difference from chance level (* $p < .05$; ** $p < .01$; *** $p < .001$).

(–6%). A post-hoc analysis (Newman–Keuls) confirmed this and showed a significant difference between volitional report and Ouija response for guessed answers ($p < .001$) but not for known ones ($p = .145$). Volitional report for guessed answers was significantly less accurate than for the other three conditions ($p < .001$), and was the only condition not significantly different than chance ($p = .961$).

In essence, when participants believed that they guessed, accuracy for volitional report was at chance (50%). But for ideomotor responses to the same questions, accuracy was 15% points higher (65%), well above chance. These results suggest that nonconscious knowledge can indeed be expressed through ideomotor actions, even when it cannot be accessed consciously, or accessed by forced-choice guessing.

3.3.2. Similarity of answers

For known answers, comparable accuracy was found for both response modalities. This raises an interesting question: How do the individual answers of the two modalities relate to each other? To answer this, we calculated for every participant a similarity index S describing the correlation of responses (either “yes” or “no”) for those questions; $S = 2P - 1$, where P is the proportion of answers similar in both modalities (ranging from 0 to 1), transformed so it can range from –1 (opposite answers) to 0 (no similarity) to 1 (same answers). S is similar to a Pearson correlation, r .

Analysis showed S to be significantly higher for known than for guessed answers (known: $M = 0.55$, $SEM = 0.1$; guessed: $M = -0.09$, $SEM = 0.1$; Wilcoxon matched pairs test, $N = 21$, $z = 3.3$, $p < .001$). Indeed, S was significantly above 0 (no-correlation level) for known ($p < .001$) answers, but not for guessed ($p = .392$). In other words, when participants believed they knew the answer, largely similar (although not identical) responses were given in the two modalities; when they did not, there was a complete decoupling.

A deeper analysis compared S for correct and incorrect answers as a function of confidence. (Correctness and confidence were both defined by volitional report). For known answers, these just failed to differ significantly (correct: $M = 0.70$, $SEM = .11$; incorrect: $M = 0.33$, $SEM = .17$; Wilcoxon matched pairs test, $N = 21$, $z = 1.8$, $p = .07$), and mean S for correct answers was significantly above zero ($p < .001$). In other words, Ouija responses tend to follow volitional reports when participants believe they know the answer, regardless of whether they actually are correct. Meanwhile, for guessed answers mean S was significantly higher for correct than for incorrect (correct: $M = 0.10$, $SEM = 0.13$; incorrect: $M = -0.30$, $SEM = 0.09$; $t(20) = 3.21$, $p < .005$), with mean S for incorrect answers significantly below the no-correlation level ($p < .005$). Thus, when the two modalities disagree and confidence is low, the Ouija response tends to be correct, and the volitional report incorrect.

3.4. Effect of previous presentation

Since half the questions used during the Ouija phase had already been presented during the pre-Ouija volitional report (list A'), the higher accuracy for guessed answers in the Ouija modality might have simply been due to their previous presentation. For example, the delay between the two presentations might have given participants time to retrieve answers they did not believe they knew at the time of the first presentation.

Such an effect is unlikely for several reasons. First, the A' questions had been “diluted” among a much larger set of 72 others. The set of Ouija responses also contained an equal number of questions that had been shown first during the Ouija phase (list B'), which would have similarly diluted the effect. Moreover, if a presentation effect did exist, it would have likely occurred in the reverse direction for list B', again reducing any overall tendencies.

A more quantitative test is to examine accuracy of Ouija response for list A' (second presentation) vs. list B' (first presentation). A *t*-test did not show any significant difference in accuracy between the two (A': $M = 59.3\%$, $SEM = 4.4$; B': $M = 66.5\%$, $SEM = 4$; $t(20) = 2.1$, $p = .278$). Mean accuracies were also assessed as a function of presentation (A'/B') and answer confidence (known/guessed) using a two-way repeated measures two-tailed ANOVA, with two participants excluded due to an absence of guessed answer for list B' ($N = 19$). Analysis showed no significant main effect of presentation (A': $M = 60.2\%$, $SEM = 4.8$; B': $M = 66.3\%$, $SEM = 4.4$; $F(1, 18) = 3.01$, $p = .101$) or answer confidence (known: $M = 61.8\%$, $SEM = 3.6$; guessed: $M = 64.6\%$, $SEM = 4.3$; $F(1, 18) = 0.44$, $p = .512$). No significant interaction between these factors was found ($F(1, 18) = .2305$, $p = .636$). In other words, the Ouija responses to questions presented previously (list A') were no more accurate than for questions which were not (list B').

Another test is based on the finding that Ouija responses tend to follow volitional ones when the answer is known (Section 3.3.2). Comparison of volitional and Ouija responses for known answers in list A' can therefore approximate the comparison of volitional responses for a first and second presentation. Accuracy for these Ouija responses did not significantly differ from the 50% for volitional reports ($M = 56.6\%$, $SEM = 6.03$; $p = .286$), again indicating that a presentation effect is unlikely.

4. General discussion

This study investigated whether ideomotor actions can express the contents of implicit semantic memory. We compared responses to yes/no questions using both volitional reports and Ouija responses. When participants believed they knew the answer, responses for both modalities were similar. When participants believed they did not know the answer, accuracy fell to chance for volitional reports (50%) but remained significantly higher for Ouija responses (65%). These results indicate that information inaccessible through volitional report can nevertheless be expressed in an ideomotor action in the complete absence of conscious awareness.

The fact that responses are similar for volitional and ideomotor responses when answers are believed to be known accords with previous findings that the explicit content of thought can be expressed by ideomotor actions (e.g., Burgess et al., 1998; Wegner et al., 1998). However, we observed this to apply as well to knowledge which cannot be expressed via volitional report. This effect is unlikely to be due to simple mislabelling: participants were instructed to label their answer as “guessed” only if they had absolutely no idea of the answer.

Related to this, Wegner, Fuller, and Sparrow (2003) showed that the expression of conscious knowledge can happen independently of the will of the participant. Thus, if the instructions here had not been followed or if participants had simply misjudged their knowledge, guessed answers should have exhibited a tendency to be better than chance. However, the overall accuracy for these failed to significantly differ from chance ($p < 0.96$)—indeed, it was almost exactly at chance level (49.8%).

Instead, our results support the proposal that ideomotor actions can express information that cannot be consciously accessed. We have also found that such expression is not limited to social knowledge or to externally-induced ideomotor actions (Chen & Bargh, 1997), but is much more general, extending to other forms of knowledge as well as to other kinds of ideomotor actions.

4.1. Implications for mechanism

What kind of mechanism might explain our results? The simplest possibility is that volitional and ideomotor mechanisms use the same representations (and thus, the same information), and differ only in the thresholds used. If so, participants who report a high level of confidence for a given answer should give the same answer in both modalities. But although overall accuracy levels were not significantly different for such answers, the similarity index (*S*) showed that the match in responses was only partial—a quarter of the Ouija responses differed from volitional reports. Moreover, when answers were guessed, the responses of the two modalities were completely uncorrelated, something unlikely if a common representation—however informative or uninformative—were used.

It might be argued that—at least for known answers—the ideomotor actions were affected by factors such as user expectation and random muscular noise, which occasionally caused a mismatch with conscious report. Also, participants were encouraged to use a liberal criterion for rating confidence, so as to be sure that “guessed” would correspond to an absence of conscious awareness. Thus, answers associated with low confidence may have sometimes been labelled as “known”, resulting in the entry of noise into responses labelled this way.

However, such factors are unlikely to explain the large degrees of mismatch found here. And they are even less likely to explain the finding that ideomotor responses can be more accurate than volitional ones. Instead, it may be that two types of mechanism are involved, drawing upon sources of information that are at least somewhat distinct. An interesting possibility in this regard is that ideomotor actions may reflect the operation of an “inner zombie”—a concurrent nonconscious system expressed primarily via motor action. Such a system has been proposed for visually-guided actions (Milner & Goodale, 1995), and a similar—or even the same—system could be at work here.

The question still arises as to how Ouija responses can be more accurate than volitional reports when confidence is low. It may be that a strong conscious belief in an answer can—at least to some degree—override the nonconscious ideomotor

response (cf. Libet, 1985), resulting in answers that are somewhat similar. When confidence is low this override would not be invoked, allowing nonconscious information to be more easily expressed.

4.2. Open issues

Although we have shown that ideomotor actions can express the contents of implicit memory, a number of issues remain unaddressed concerning the mechanisms involved. Could anything more be said about specific components responsible for the effects found here?

In our experiment, volitional report and Ouija response differed on two dimensions: the feeling of authorship over the *initiation* of the motor response, and the feeling of authorship over the *answer*. In volitional report the participant feels responsible for initiating the movement produced (mouse movement), as well as for the content of an answer; in Ouija response, they feel responsible for neither. An interesting issue is whether the effects of these two dimensions can be separated out, and if so, what role each might play.

Devising an experimental protocol to investigate this will be a challenge: participants will probably not feel responsible for the content of an answer if they do not feel responsible for the movement to begin with. A diminished sense of responsibility/feeling of authorship over the content of the answer might be created by decreasing the degree of responsibility (e.g., telling the participants that the individual answer would be pooled to produce a group answer) or lowering their feeling of authorship over the answer (e.g., participants report what they feel another person would answer (Wegner et al., 2003)). Such a result would not exclude the role of the involuntary movement involved in the ideomotor response, but could open the door to protocols not requiring motor answer.

Another interesting issue concerns the role of introspection. In a signal detection task, higher accuracy levels are observed when participants are instructed to guess rather than use their perceptual experience (Marcel, 1993); this has been interpreted as due to the absence of introspection (Overgaard & Sorensen, 2004). In our study the absence of introspection corresponds to the Ouija response but not the volitional report; even when participants were guessing they had first to introspect. Examining the effect of instructions that induce an introspective (vs. non-introspective) strategy could be helpful here.

Finally, it is also worth investigating the role of the response modality used. In a detection task, higher accuracy is observed for a blink response than for a verbal answer (Marcel, 1993), suggesting that interesting differences may exist in different modalities. In our experiment we attempted to maximize the similarity of the two types of responses (mouse movement toward an answer on screen vs. planchette movement toward an answer on the board). But these responses may still have differed in important ways (e.g., one hand vs. two hands), affecting the pattern of results obtained.

4.3. New directions

At a more general level, the results of this study have shown that it is possible to use ideomotor actions to access non-conscious knowledge. This opens up the possibility of investigating several interesting sets of research issues. One of these sets centres around ideomotor actions themselves, such as the role of a diluted (or absent) sense of agency, its relation to the sense of responsibility, the relationship between conscious confidence level and ideomotor response, and the operation of the override mechanism. Another concerns various aspects of implicit memory, such as the particular kinds of knowledge that exist, the way they are learned, and the fidelity with which they are stored.

It is important, however, to note that the approach developed here has several limitations that prevent it from easily scaling up to address such issues. First, response times for Ouija can sometimes require several minutes. This limits the number of conditions than can be tested within a given group of participants. Second, there is considerable variability of the ideomotor effect. Only two participants out of the twenty-seven tested showed no ideomotor response at all. But four others, despite exhibiting an ideomotor behaviour, produced answers which could not be interpreted in term of yes/no. As such, it would be useful to develop new ideomotor-based devices that allow shorter response times and therefore a higher number of observations. Ideally, these devices would also have less variability in the responses of the participants.

But regardless of how far it can ultimately be scaled up, the approach developed here still provides an interesting new way of studying implicit cognition. Its further development will likely continue to provide new insights into the relation between explicit and implicit processing, and the nature of the mechanisms involved.

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Appendix. Instructions to participants

Pre-and post-Ouija volitional reports

“For each question click on the answer of your choice, yes or no, and then click on your level of confidence. Please choose *Guessed* only when you had absolutely no idea of the answer, in any other case please chose *Known*. You can take the time you want to read and answer each question.”

Training for Ouija responses

“I will read a question. Please listen carefully to the question and then place the tip of your right and left forefingers very lightly on the planchette. You will have to keep your arms held out; do not let them rest on the table or up against your torso. Your task is to do nothing but wait until the planchette starts moving. When the planchette moves just follow the movement. Please do not try to initiate the movement or modify the trajectory. I will let you know when you can remove your hands from the planchette.”

Ouija responses

“Now the task will be exactly the same but you will have to wear a blindfold. I will read the question and then I will place your fingers on the planchette. Remember that your task is only to follow the planchette. Do not try to initiate the movement or modify the trajectory. If at some point you estimate you are responsible for its movement in any way, please silently nod your head.”

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