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The Acquisition of English Locative Constructions by Native Speakers of Korean: Pragmatic Competence or Syntactic Incompetence?

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1. INTRODUCTION

To understand a verb’s meaning and use it correctly, a second language (L2) speaker must learn in what syntactic structures the verb is allowed. Across languages, there are some consistent verb semantics-syntax correspondences, and knowing these regularities can help an L2 learner assign correct syntactic structures to verbs. For example, if a learner understands that mental verbs such as “think,” “know,” and “hope” take a sentential argument, then he or she can use this mental verb-sentential complement “linking rule” to infer that a verb like “wonder” will also take a sentential complement (Kim et al., 1999).

However, there are more complex types of verbs that are subject to greater argument structure variation, which pose difficulty for many L2 learners. These verbs may appear in different syntactic structures but have the same arguments, or may appear in the same syntactic structures but have different arguments. Locative verbs in English are one such kind of verbs which are subject to great variation. They denote a relationship between a thematic entity (Figure) and a location (Ground). For example, the locative verb load links an object to a place it can be moved and can participate in alternation as follows:

1) Mary loaded the truck (ground) with hay (figure).
2) Mary loaded the hay (figure) onto the truck (ground).

Research shows that there are cross-linguistic differences (and similarities) in the syntax of locative verbs, and this paper will address how successfully native speakers of Korean acquire the syntax of locative constructions in English in the face of these variations. Pinker (1989) argued that there are two important types of rules that are associated with the acquisition of the L2 syntax of locative verbs. These rules—broad-range rules and narrow-range rules—illuminate the distinction between the acquisition of the knowledge of 1) broad constructional meaning and 2) narrow constraints distinguishing the various syntactic subclasses of locative verbs.

Korean L2 learners’ success in learning the syntax of English locative verbs, therefore, depends on how fully they have apprehended these rules. Studies show that while many Korean learners of English have a firm grasp of the broad-range rules, even advanced Korean-English bilinguals have limited knowledge of narrow-range rules that govern more language-specific properties and define subclasses of locative verbs. Some researchers
including Bley-Vroman and Joo (2001) and Joo (2003) have interpreted Korean speakers’
difficulty with narrow constraints as an indication that Universal Grammar (from here on
referred to as UG) is not available in L2 acquisition; however, others like Schwartz et al.
(2003) have challenged this claim, asserting that the difficulty is a sign of pragmatic
competence rather than of UG inaccessibility.

The goals of this paper are, therefore, as follows: 1) to demonstrate how the Korean
syntax of locative verbs differs from its English counterpart; 2) to discuss how Pinker’s broad
and narrow rules guide native Korean speakers’ syntactic interpretation of English locative
verbs; and lastly, 3) to present and evaluate the different theories accounting for Korean L2
learners’ difficulty acquiring narrow-range rules and making subtle distinctions among
various argument structures of locative verbs.

2. ENGLISH LOCATIVE CONSTRUCTIONS

The difficulty of learning locative verbs in English is apparent if we just consider the
number of classes into which they can be categorized. Some locative verbs are
“Content-oriented,” indicating the content’s (Figure’s) manner of motion, while others are
“Container-oriented,” indicating the change of state, or end state, of the container (Ground)
rather than the manner in which the Figure is affected. Linguists often refer to the former as
Figure verbs and the latter as Ground verbs. Figure verbs and Ground verbs can be further
classified into two groups, depending on which argument(s) can appear in the direct object
position and whether they can be alternators or not. This classification results in the
following four syntactic subclasses of locative verbs:

(1) Non-alternating Figure verbs (e.g., pour, dribble, spit, spill) allow the theme
argument (the Figure) but not the goal argument (the Ground), to be the direct object:
   a. Josh poured milk into the jar.  Figure-Ground (“Figure frame”)
   b. *Josh poured the jar with milk. *Ground-Figure

(2) Non-alternating Ground verbs (e.g., fill, cover, soak, decorate) allow the goal
argument (the Ground), but not the theme argument (the Figure), to be the direct
object:
   a. Sarah filled the pitcher with water. Ground-Figure (“Ground frame”)
   b. *Sarah filled water into the pitcher. *Figure-Ground

(3) Alternating Figure verbs (e.g., spray, plaster, pile) allow either the Figure or the
Ground to be the direct object:
   a. Laura sprayed paint onto the wall. Figure frame
   b. Laura sprayed the wall with paint. Ground frame

(4) Alternating Ground verbs (e.g., load, stuff, paint) allow either the Ground or the
Figure to be the direct object:
a. Mary loaded the truck with hay. Ground frame
b. Mary loaded hay onto the truck. Figure frame

L2 learners will benefit from learning the above syntax-semantics correspondences, i.e., from recognizing, for instance, that those verbs describing a manner of motion are Figure verbs and therefore allow the Figure to be in the object argument. Knowing that a verb—spill, for example—shares the semantic property of “manner of motion” with the verb pour will be necessary for determining that its syntax, too, constitutes the Figure frame.

3. KOREAN LOCATIVE CONSTRUCTIONS

Kim et al. (1999) reported, however, that cross-linguistic differences exist in the syntax of locative verbs, which suggests that the aforementioned syntax-semantic correspondences may not be universal, weakening the reliability of learning strategies based on universal syntax-semantics mapping. In Korean, some locative verb classes show the same syntactic structures as their English counterparts, while other classes are either “syntactically more liberal” or “syntactically more restricted” than their English counterparts. The following examples illustrate some of the differences between the two languages:

(1) Change-of-state verbs like fill are Non-alternating Ground verbs in English; however, they are Alternators in Korean:
   Yumi-NOM water-ACC cup-LOC fill-past-Decl.
   *“Yumi filled water into the glass.”
   *Figure frame
   Yumi-NOM cup-LOC water-with fill-past-Decl.
   “Yumi filled the glass with water.”
   Ground frame

(2) Some verbs that are Alternators in English (e.g., pile) are Non-alternating Figure verbs in Korean:
   “Yumi piled the books on the table.”
   Figure frame
   Yumi-NOM desk-ACC books-with pile-past-Decl.
   “Yumi piled the table with books.”
   Ground frame

The following examples show that some instances of locative constructions are identical in Korean and English:

(3) Change-of-state verbs like pour are Non-alternating Figure verbs in both English and Korean:
Yumi-NOM water-ACC glass-LOC pour-past-Decl.
“Yumi poured water into the glass.”     Figure frame
Yumi-NOM cup-ACC water-with pour-past-Decl.
*“Yumi poured the cup with water.”     *Ground frame

(4) Some verbs that are Alternators in English (e.g., *paint*) are also Alternators in Korean:

Yumi-NOM oil-ACC wall-LOC paint-past-Decl.
“Yumi painted the oil onto the wall.”     Figure frame
Yumi-NOM wall-ACC oil-with paint-past-Decl.
“Yumi painted the wall with the oil.”     Ground frame

The following table, adapted from Choi & Lakshmanan (2002), succinctly captures which locative constructions are allowed in each language (√ = allowed):

<table>
<thead>
<tr>
<th></th>
<th>English Alternating</th>
<th>English Non-alternating</th>
<th>Korean Alternating</th>
<th>Korean Non-alternating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure</td>
<td>√</td>
<td></td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>Ground</td>
<td>√</td>
<td></td>
<td></td>
<td>√</td>
</tr>
</tbody>
</table>

4. PINKER’S BROAD-RANGE AND NARROW-RANGE RULES:

4.1 Broad-range rules and broad conflation classes and the Object Holism Effect

Pinker (1989) distinguished between two aspects of the acquisition of locative verb constructions in L2: 1) the broad constructional meaning of “broad conflation classes” and 2) more subtle, selective constraints distinguishing “narrow conflation classes” or “conflation subclasses” of locative verbs. Learners first acquire the broad constructional meaning of locative verbs based on so-called broad-range rules. The classes of verbs to which they apply are called broad conflation classes and include the two aforementioned semantic categories, 1) manner-of motion (Figure) verbs and 2) change-of-state (Ground) verbs.

Broad-range rules provide the necessary criteria by which learners determine whether a verb can participate in the locative alternation. That is, for a verb to be an alternator, it must, as a minimum necessary, though not sufficient (more on this below), requirement, belong to a broad conflation class. If a learner knows that a verb specifies both a type of motion and a change of state, then it must be an alternator. For example, the verb *stuff* is an alternator because it can appear in both the into/onto form (which indicates that some motion has taken place) and in the with form (which indicates that an object has undergone a change of state as a result of some motion). Conversely, if a verb specifies either a type of motion or a change
of state but not the other, it is not an alternator. For example, *fill* is a non-alternating verb because it describes an end state (“she filled the glass with water”) but not a type of motion (**“she filled water into the glass”**); thus, it can appear with the preposition *with*, but not with *into/onto*, and belongs to the broad conflation class *manner of motion verbs*. Therefore, broad-range rules, which define the two broad conflation classes, aid L2 learners in understanding just the general properties of verbs (manner of motion or change of state?) and in determining whether they satisfy the minimum requirement that allows them to participate in the locative alternation. These rules have been reported to be universal; that is, locative verbs in all languages have the two broad semantic constructions. Investigating this universality, Kim et al. (1999) made the following important generalization that seems to apply to all of the languages they examined:

- **Universal syntax-semantics correspondence**: Verbs with manner-of-motion meaning allow the Figure frame.

More specifically, Kim (as cited in Schwartz, 2003) stated that “the class of non-alternating Figure verbs like pour is syntactically identical across all of the languages” (p. 251) that she surveyed in that:

- **Pour-class** manner-of-motion verbs allow only the Figure frame. The absence of cross-linguistic variation in the pour subclass is evidenced by the fact that children are more prone to make errors mapping change-of-state meaning to Figure frame (e.g., **“John filled water into the glass”**) than mapping manner-of-motion meaning to Ground frame (e.g., **“John poured the glass with water”**), suggesting that the syntax-semantics correspondence involving manner-of-motion meaning will be easier to learn because of its universality.

An important concept related to Pinker’s broad-range rules is the object holism effect. This describes the phenomenon in which the object of Ground verbs is perceived as completely affected. Compare, for example, the following sentences:

(1) Mary *loaded* the truck ground with hay figure. Ground frame
(2) Mary *loaded* hay figure onto the truck ground. Figure frame

Both native speakers of English and Korean consider the direct object, “the truck,” in (1) to be completely loaded, whereas they do not show this holism effect when interpreting (2). Joo (2003) reported that even though the holistic interpretation in Korean locative verbs is much weaker than that in English locative verbs, Korean L2 learners still show the native-like bias for holism when interpreting English locative constructions. In part 1 of her experiment, a forced-choice picture-description task, each subject was presented with an English sentence, either in the Figure frame or the Ground frame, and was instructed to choose between two illustrations, one in which the ground argument was completely affected (“Ground-oriented picture”) and another in which the ground argument was only partially affected (“Figure-oriented picture”). The results of this task showed that both native English speakers and Korean L2 learners had knowledge of the broad-range rules and the holism effect: they 1) chose Ground pictures for sentences containing change-of-state verbs and Figure pictures sentences containing manner-of-motion verbs and 2) chose the sentences whose direct object was the ground argument when presented with a picture whose ground was completely affected.
By specifying what kind of verbs are allowed in the Ground frame, the holism effect can aid L2 learners in predicting the syntax of some arguments:

(3) a. Irv loaded hay into the wagon.
    Irv sprayed water onto the flowers.
    Irv threw the cat into the room.
    Irv pushed the car onto the road.

b. Irv loaded the wagon with hay.
    Irv sprayed water onto the flowers.
    *Irv threw the room with the cat.
    *Irv pushed the road with the car. (Pinker, 1989, p. 49)

These examples show that in the Ground frame, where the goal argument is the direct object, only those verbs whose goal is completely affected by the theme may undergo the locative alternation. The last two sentences in 3b are ungrammatical because the verbs *threw and *pushed entail actions that “cannot result in complete filling or depletion” (p. 50). Since the holism effect does not apply to these verbs in the Ground frame, they are not eligible to participate in the locative alternation.

4.2 Narrow-range rules and narrow conflation classes and learners’ difficulty with them

It has been established earlier in this paper that for a verb to participate in the locative alternation, it must necessarily belong to a broad conflation class (manner of motion or change of state). This, however, is not a sufficient criterion. It must additionally belong to one of the narrow conflation classes—Non-alternating Figure, Non-alternating Ground, and Alternating verbs—which are defined by the narrow range rules. These rules distinguish the various subgroups within the broad conflation classes, outlined above in section 2 (“English locative constructions”).

Studies show that while Korean L2 learners of English acquire knowledge of the universal broad-range constraints and the holism effect easily, they display limited knowledge of the more language-specific properties of locative verbs that are associated with the narrow-range rules. For example, in order to test how successfully Korean L2 learners acquire the argument structure of English locative verbs, compared to native speakers of English, Joo (2003) employed a forced-choice sentence selection task in addition to the forced-choice picture-description task that was described above —and concluded that knowledge of narrow-ranges rules is much more difficult, if not impossible, to attain for Korean L2 learners.

In this task, the subjects were presented with two sentences—ground- and figure-constructions— and were required to choose the one that better described a given picture, or choose “neither.” Half the pictures used in the experiment showed completely affected arguments and the other half showed partially affected arguments. The dependent variable was the frequency with which the subjects chose ground-sentence responses (“degree/means of groundness”). If a subject chose a ground-construction sentence, he or she received one point; if a subject chose either of the remaining options, a figure-construction sentence or “neither,” no points were given.
The results showed that in the native English group (Figure 1), the means of groundness in the Ground verb class was significantly higher (3.88) than those for the other two verb classes, Alternating and Figure (3.24 and 0.41, respectively). Moreover, for both context types, Figure-oriented pictures and Ground-oriented pictures, the means of groundness in the Figure verb class were very similar—virtually zero. In other words, regardless of which type of picture they were shown, the native English speakers rejected all the Ground-object frames of the figure class verbs because they were ungrammatical. For example, they rejected sentences like “John poured the glass with water” whether they were shown a picture of a full glass or a half-filled glass.

Figure 2. Korean L2 learners of English
In contrast, in the L2 learners group (Figure 2), the means of groundness in the Figure verb class differed on the basis of context type, i.e., it was significantly higher for Ground-oriented pictures than for Figure-oriented pictures. For example, they were more likely to accept sentences like “John poured the glass with water” when presented with Ground-oriented pictures than when presented with Figure-oriented pictures. This shows that they had not yet learned that verbs like *pour* do not allow the Ground frame in any case. Moreover, the patterns of groundness were similar across all three verb classes in this group: in each verb class, the means of groundness was low in figure contexts and high in ground contexts. In other words, the L2 learners chose Ground-object sentences when presented with Ground-oriented pictures and Figure-object sentences when presented with Figure-oriented pictures, showing that they were heavily influenced by the holism effect and had not yet acquired knowledge of narrow class constraints.

Consider the following example: When Figure pictures were presented with a partially affected ground argument (about half the time), the native English speakers chose the grammatical Ground frame sentences or chose neither, showing a strong dislike for using Non-alternating Ground verbs in the Figure frame, especially *fill* and *cover*. However, the L2 learners were strongly influenced by the holism effect, which led them to choose ungrammatical Figure frame sentences. Here is what I mean:

**e.g., picture presented:**

![Example image](image.jpg)

*(Partially affected ground)*

Sentences to choose from:

(a) John filled water into the glass.
(Korean speakers choose this ungrammatical Figure frame, succumbing to the holism effect.)
(b) John filled the glass with water.  
(English speakers choose this grammatical Ground frame, overcoming the holism effect.)

(c) Neither.  
(English speakers rejected both sentences.)

Joo’s results would predict that in this example, the native English group would choose (b), a Ground frame sentence which favors the holistic interpretation, even though the picture shown presents only a partially affected argument (a half-filled glass) because (a) is ungrammatical, or they would choose (c) neither, showing sensitivity to both the holism effect and to the constraints on the fill verb class. In contrast, the Korean speakers would choose the Figure frame sentence (a), which is ungrammatical in English but grammatical in Korean. L2 learners are highly sensitive to the holism effect; seeing that the glass in the picture is not wholly affected, they would choose the sentence that does not entail holism but is ungrammatical. This inappropriate extension of the holism effect, which results in their acceptance of the ungrammatical locative construction, suggests that they have not acquired full knowledge of what language-specific constraints are placed on narrow conflation classes of locative verbs.

5. THEORIES ACCOUNTING FOR KOREAN L2 LEARNERS’ DIFFICULTY ACQUIRING NARROW CLASS CONSTRAINTS

5.1 Inaccessibility of UG in L2 acquisition: Syntactic incompetence

Bley-Vroman and Joo (2001) stated that the Korean L2 learners’ lack of knowledge of the narrow constraints is due to their inability to “determine which verbs cannot occur in a construction” (p. 210)—a negative evidence problem. Children, on the other hand, are able to acquire native-like knowledge of these narrow constraints in the absence of negative evidence—“evidence about which word strings are ungrammatical” (Pinker, 1989, p. 6)—because Universal Grammar is set up to deal with it. Therefore, L2 learners’ inability to make fine discriminations among various narrow conflation classes is due to their failure to overcome this negative evidence problem, which in turn is evidence that UG is inaccessible in L2 acquisition. This lack of negative input, as discussed in the previous section, causes L2 learners to overgeneralize argument structures of locative verbs via the holism effect and use ground-object constructions for figure verbs and figure-object constructions for ground verbs. It is true that children often make similar argument-structure overgeneralization errors. Pinker (1989) pointed out that they, too, apply broad-range rules or have systematic misconceptions about the meanings of some verbs. However, unlike L2 learners, they are able to retreat from this overgeneralization. Joo (2003) attributed L2 learners’ insufficient knowledge of the narrow constraints and failure to recover from overgeneralization to their
incomplete use of a learning mechanism called semantic structure hypothesis testing. According to Pinker (as cited in Joo, 2003, p. 325), children use the following three mechanisms in learning lexical meaning:

1) Event-category labeling (‘linking verb meanings onto the mental representation of concepts’);
2) Semantic structure hypothesis testing (‘adjusting any incorrect hypothesis by observing how the verb is used across situations’); and
3) Syntactic cueing of semantic structures (‘learning verb meanings from argument structures’).

But unlike children who can exploit all three mechanisms equally well, L2 learners are not given as many opportunities to observe how the various argument structures of locative verbs are used in real-life situations. Most of their verb input comes from “discourse context in reading or listening passages” (p. 325). Unfortunately, ESL materials do not provide adequate input on verbs and their syntactic structures, and, as Juffs (1998) pointed out, over-represent those classes of verbs that provide “survival skills” in communication (e.g., experiencer psych verbs and unergatives) while under-representing others (e.g., transitive causative/inchoative-change-of-state and movement verbs and stimulus psych verbs) with which learners have particular difficulty.

Because of this poverty of input, L2 learners do not get to use as much the second learning mechanism, semantic structure hypothesis testing, which requires observation of the use of a verb in many different real-life situations and then figuring out its argument structure(s) from its meaning. Instead, they rely heavily on the third mechanism, syntactic cueing of semantic structures, through being exposed to sources such as example sentences in textbooks and dictionaries. For L2 learners, therefore, the acquisition of syntactic argument structures seems to precede that of semantic structures (Joo, 2003). That is, they seem to learn argument structures of locative verbs based on explicit syntactic information rather than from a semantic understanding. Unfortunately, their acquisition of these syntactic argument structures is based on limited sources—e.g., ESL textbooks rather than real-world input—which do not provide sufficient input to guide them to make correct syntax-semantics correspondences when it comes to narrow conflation classes.

Bley-Vroman and Joo (2001) also pointed out that although L2 learners do attain some knowledge of narrow constraints by relying on “what has been heard or what has not been heard” (p. 216), they are unable to apply them to novel verbs, showing reduced linguistic productivity. For example, in Bley-Vroman and Yoshinaga’s (as cited in Bley-Vroman & Joo, 2001) study testing the grammaticality judgment of native English speakers and Korean L2 learners, they found that the latter responded differently when they were presented with real verbs than when they were presented with made-up verbs. Unlike the native English speakers, they failed to apply the narrow constraints to novel verbs of the same semantic classes.

This led the researchers to conclude that it is “difficult or impossible” for L2 learners to attain “principled knowledge of narrow classes,” which distinguish verbs like *fill* from
verbs like *pour*. Because UG—which allows native speakers to “act on principle” and show early syntactic productivity—is inaccessible in L2 acquisition, L2 learners must learn the narrow constraints in an “unprincipled” way, i.e., by association (relating certain syntactic constructions to certain meanings) based on (limited) input exposure and explicit instruction. The hypothesis that L2 learners’ knowledge of narrow rules is not principled is supported by the fact that learners make correct grammatical judgments about only some verbs in specific contexts (i.e., those which they have been explicitly taught) in a forced grammaticality judgment test but not in the more meaning-oriented picture-choice task described above.

### 5.2 Coercion: Pragmatic competence

Recall that L2 learners’ limited knowledge of narrow constraints is associated with their inability to recover from their overgeneralization of the holism effect. Bley-Vroman and Joo (2001) argued that this is due to the unavailability of UG in L2 acquisition. Most researchers do acknowledge that L2 learners’ acquisition of narrow constraints is not native-like; however, Schwartz et al. (2003) consider their holism-triggered narrow range errors to be caused by a phenomenon known as contextual coercion, which is evident even in L1 acquisition, and propose a convincing alternative to the theory of UG inaccessibility L2 acquisition.

According to this account, L2 learners “contextually coerce verbs beyond their lexical specifications” (p. 257). Consider the following simple examples of coercion:

(1)   
   a. The light flashed (until dawn).  
   b. John is resembling his father *(more and more).*

   (Jackendoff, as cited in Schwartz, 2003)

Notice that in (1a), the meaning of the verb “flashed” changes when the Adverb phrase “until dawn” is inserted. When we consider the meaning of the verb “flash” in isolation or in the context of a very simple structure like “The light flashed,” we visualize a single sudden burst of brightness. However, the addition of “until dawn” coerces the hearer to extend its meaning to “*repeatedly flashed.*” In other circumstances, contextual coercion can even change the grammaticality status of a sentence, as in (1b).

Schwartz et al. (2003) asserted that contextual coercion can apply to L2 learners’ acquisition and interpretation of locative constructions in English. They argued that in part 2 of Bley-Vroman and Joo’s (2001) study, the L2 learners simply extended the verb meanings to describe the pictures that showed completely affected goal arguments (Ground-oriented pictures). This in no way entails that UG is inaccessible in L2 acquisition. They also pointed out that coercion can occur in the L1 acquisition of locative constructions by children, for whom UG is available:

(2) Coercion in child language acquisition:
   a. E, 2;11: Pour, pour, pour. Mommy, I poured you. [Waving empty container near M.]
M: You poured me?
E: Yeah, with water.

In light of such examples, some researchers have asserted that the holism effect, rather than deriving from UG-constrained syntax-semantics linking, is a mere pragmatic effect. For example, Rappaport and Levin (as cited in Pinker, 1989) claimed that it is simply “an epiphenomenon of the fact that the verb specifies a change of state” (p. 78). They pointed out that the sentence “The vandal sprayed the statue with paint” would remain grammatical and strictly true even if only a dab of paint was sprayed on the statue. Jackendoff (as cited in Schwartz, 2003) also drew attention to the context-dependent nature of the holism effect, noting that its strength depends on the type of predicate:

(3) a. Bill sprayed/smeared/dabbed splashed the wall with paint (for ten minutes), but it still wasn’t covered.
b. ?Bill loaded the truck with dirt for an hour, but there was still room for more.
c. ?Bill crammed/packed the crack with cement (for five minutes), but it still wasn’t full.

(as cited in Schwartz, 2003, p. 249)

Moreover, Lee (1997) suggested that the holistic interpretation in Korean (weaker than that in English) becomes strong with the insertion of intensifying adverbs such as wancenhi or katukhi (“completely”).

In English, too, the insertion of a word like “full” can significantly improve a sentence like (4a). This is possible because the modification has extended the hearer’s semantic representation of the verb pour in (3b) via contextual coercion.

(4) a. *John poured the glass with water.
b. John poured the glass full with water. (Pinker, 1989)

These examples are strong evidence in support of the hypothesis that holism is not “a strictly semantic inference” (Schwartz, 2003, p. 249). The strength of its effect is variable across different sentence contexts, dependent on such factors as verb type and whether or not an intensifying adverb is present. Yet it manifests itself in only one type of syntactic structure, the Ground frame, and is part of the broad constructional meaning aspect of locative verb knowledge, which is governed by broad-range rules deemed to be universal and thus easily grasped by L2 learners. Therefore, more research is needed to verify whether holism is simply a matter of implicature. Understanding its nature will be crucial to determining whether or not, and/or the extent to which, UG is accessible in the acquisition of the L2 syntax of locative verbs.
6. CONCLUSION

The syntax of locative constructions has sparked great interest among linguists because it involves various cognitive-linguistic concepts including changing states, moving objects, and being affected (Bley-Vroman & Joo, 2001). The acquisition of these concepts is reflected in a learner’s ability to correctly associate themes with specific syntactic structures. Pinker stated that knowledge of both broad constructional meaning and narrow-range constraints is necessary to attain a native-like understanding of the syntax-semantics correspondences in locative constructions in L2.

This paper addressed specifically Korean speakers’ acquisition of the broad-range and narrow-range rules and discussed relevant research. Studies show that while Korean learners of English have knowledge of universal broad constraints, they have trouble distinguishing the language-particular narrow conflation classes, which are defined by narrow-range rules. Their failure to readily acquire the narrow constraints has been associated with an inappropriate extension of the holism effect. Some researchers have attributed this to UG inaccessibility in L2 acquisition, while others have challenged this claim, arguing that the overgeneralization of holism may be due to a pragmatic phenomenon known as contextual coercion. Until research can verify that holism is not a mere pragmatic effect, it seems that Schwartz et al. are correct to challenge the hypothesis that adult L2 acquisition is not UG-constrained.

References


Quantifying the Effect of a Logotype on Perceived Market Value of Consumer Products

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Abstract

This study is designed to measure the effect of a logotype on the perceived market value of consumer products among Vanderbilt undergraduates. An analysis of quantitative descriptive research from 291 Vanderbilt University undergraduate students shows that adding the logotype of a premium brand can increase the perceived value of a product compared to the unbranded version while adding a budget brand’s logotype can either increase or decrease the perceived value of the unbranded version. These findings illustrate the importance of determining the perceived value of a brand and developing strategies to increase positive brand perception among consumers even if that means disassociating the product from its brand name. This is the only research to date examining the impact of a logotype on the perceived market value of consumer goods.

I. Introduction

In a marketplace full of alternatives for consumers, brands are fighting for a way to establish superiority over the competition. Some brands are focusing on external issues such as “going green” and being environmentally friendly, while other brands are renovating their images from within. These changes are designed to improve the image of the brand in the eyes of consumers. Consumers’ perceptions of a given brand have the potential to enhance the brands’ success if positive brand equity is established.

Farquhar (1989) defines brand equity as the additional value with which brands endowed products. Aaker (1991), Swait et. al, (1993), and Keller (1993) support Farquhar’s (1989) definition by defining brand equity as the value that a brand adds to a product. A third definition is provided by other researchers, who state that brand equity is the incremental preference endowed by the brand to the product as perceived by an individual consumer (Park and Srinivasan 1994). The market share premium due to brand equity shows, when all else is equal, how much of a brand’s current market share is due to the brand’s equity (Park and Srinivasan 1994). The portion of Coca-Cola’s market share due to brand equity, for
example, is due to the brand name “Coke” and the emotional connection to the brand rather than taste preference for the actual product.

Significant research has indicated that brand equity is driven by brand associations and brand image (Aaker 1991; Keller 1993; Aaker & Keller 1990; Biel, 1992). Research has attempted to calculate exactly how brand equity is influenced by several factors, including product attributes and advertising initiatives, and measured in a number of ways from surveys (Park and Srinivasan 1994) to scanner panel data (Erdem, Zhao, and Valenzuela, 2004). Although many people assume that stronger, higher-quality brands have more equity than weaker competitors (Biel, 1992), brand quality and brand equity are not causally related. K-mart, for example, is a strong brand with high brand equity, but it is not associated with high quality. Erdem, Zhao, and Valenzuela, (2004) found that brand equity is driven by a brand’s consistency and credibility, not necessarily by perceived quality of the brand. Even though K-mart is not associated with high quality, it is a consistent brand with a stable brand image and has considerable brand equity.

Variables such as extrinsic product cues can influence the perceived value of a given product. Extrinsic cues are market determined, intangible attributes and characteristics associated with a product (Cordell, 1997). Examples of extrinsic cues that relay important information to consumers include the product’s country of origin, the brand itself, and the retail outlet where the product is sold. Respected retailers are believed to develop positive attitudes about the product (Cordell, 1997) and thus increase perceived value. A consumer might feel more confident purchasing a camera from Best Buy than they might be buying that same camera elsewhere because of Best Buy’s expertise and experience in electronics. Similarly, one might have a more positive perception of a diamond ring purchased at Tiffany & Co. than a similar ring purchased from a dark booth in a marketplace. The relationship between the type of retail outlet and the perceived quality of an item, however, has not been shown to be statistically significant (Rao and Monroe, 1989). In addition to retail outlets, previous research has also found that consumers report perceptions of products from industrialized countries as being superior to products made in unindustrialized countries (Cordell, 1997).

Brand perceptions are strongly attached to the brand logo. A brand’s logo is the identifying symbol of brand that conveys a plethora of information to consumers. Previous research supports that when logos are altered or missing, consumers may attribute entirely different characteristics to the product. A particularly interesting area of research has emerged from discrepancies in reported taste preferences due to the presence or absence of brand identification on labeled and unlabeled drinks. Alison and Uhl (1964) conducted a study in which beer drinkers sampled several labeled and unlabeled beers and completed an evaluation on each beer to identify the influence of the brand’s identification on the perception of taste among participants. They found that overall ratings for each of the brands tested increased with brand identification.

Another study conducted by Wansink, Payne, & North (2007) also illustrates how logos and labels can give valuable information to consumers that can alter their perceptions of a product. In their study, forty-nine undergraduate students were shown one of two bottles of wine that were relabeled to clearly stated the origin of the wine as being from California or
North Dakota (although the same wine was in each bottle). The only difference between the two bottles was that the researchers manipulated the wine label to state that the wine was from California for one group or North Dakota for another group. After being shown the bottle, participants were asked to rank the how tasty they expected the wine to be on a 9-point scale. After tasting the wine and a cube of cheese that researchers gave participants with their wine the participants ranked how tasty the wine and the cheese were.

The participants who were shown a bottle from “California” ranked the expectation and actual taste of the wine and the taste of the cheese more highly than the participants who were shown the “North Dakota” wine. The California labeled wine was ranked 5.19 for expectation, 5.18 for taste, and the cheese that accompanied it was ranked 4.46. The North Dakota labeled wine was ranked 2.76 for expectation, 3.68 for taste, and the cheese that accompanied it was ranked 3.31. Since the only difference between the group were the words “North Dakota” and “California” on the label, one can assume that the differences in the groups stems from perceptions of California and North Dakota wine (Wansink, Payne, & North, 2007).

An expression of consumer’s perceived value of a given brand can be seen in the prices that consumers are willing to pay for such an item. A common place to see price discrepancies due to perceived value is in supermarkets, where canned foods that are made by the same manufacturers are then labeled and branded with different companies’ logos before being distributed to retail outlets. Hawes and Kiser (1980) found that “generic brand grocery products were 30 percent to 40 percent less expensive than respective manufacturers’ brands and about 20 percent below the retail price of respective private brands” (Hawes and Kiser, 1980 as cited in Herstein and Tifferet, 2007). If the quality of the food is kept constant across these brands, it is the consumers’ perception of one brand having more value than another that allows stores to charge a 40-percent price increase on some brands and not others.

In addition to extrinsic cues, another set of cues that shape consumer’s perspectives of a given brand are intrinsic cues. Intrinsic cues are palpable physical attributes and performance specifications, such as 1”50 horsepower” or “1200 watts” (Cordell, 1997). The present study does not rely on intrinsic cues because “to give specific model information may direct the study to be more a test of familiarity” (Dodds, Monroe, Grewal, 1991). Any additional intrinsic cues that may be conveyed through the images shown to participants are equated in the design of this study.

A consumer’s familiarity with a product also shapes his or her perception of the brand. Familiarity refers to number of product related experiences that have been accumulated by the consumer (Alba and Hutchinson 1987). Familiarity has been operationalized to mean accumulated purchases (Anderson, Engeldow, & Becker, 1979), product usage (Johnson & Russo, 1984), search, ownership, and experience (Park & Lessig, 1981; Park, Mothersbaugh, & Feick, 1994). In order for consumers to recognize a given logotype he or she must be familiar with the brand. Researchers Rao & Sieben (1992) found that consumers with both low and high expertise with a given brand place greater confidence on the brand name as an indicator of the quality than consumers with moderate familiarity. The present study chose to use brands with which Vanderbilt undergraduate students were highly familiar.
In a previous study investigating undergraduate students, Dodds, Monroe, Grewal (1991), evaluated college students’ perceived value for different brands using a 5 x 3 x 3 between subjects factorial design for two products with four store names, and four brand names. After conducting pretests, they chose to test a calculator (Hewlett Packard or Royal brand sold in either a campus bookstore or Roses) and a stereo headset player (Sony or Grand Prix brand sold in either Best or K-mart). Dodds, Monroe, and Grewal chose three prices “determined to be perceptively different, yet within the subject’s acceptable price ranges... positioned as a high price, a medium price, and a low price for each product” (1991). Perceived value was operationalized in terms of monetary exchange in this study.

The present study was designed to investigate the effect of a logotype on the perceived market value of consumer products among Vanderbilt Undergraduates. No research has been done to date that measures incremental changes in brand equity by isolating a logotype. One study does, however, analyze how a well known vs. unknown brand’s logotype influences recall of an advertisement that is identical except for the logotype shown (Manville, 1965). The present study operationalized perceived value as the suggested retail price for a given item.

The present study is interested in identifying the estimated perceived market value for identical products labeled with different brand logos. Since a given brand’s extrinsic characteristics can be changed without fundamentally altering the physical makeup of the product itself, this study will keep the image of the product shown to participants constant and will only alter the identifying brand information of the logotype. The only information provided about the products is the brand. This is similar to real life shopping experiences, when extrinsic cues such as a brand or logo are the only source of identifying information about a product (i.e., when no description of the product is given or when ordering an item online or from a magazine).

Any biases associated with information conveyed to consumers via extrinsic cues have been accounted for in this present study. The influences retail outlets are eliminated since the type of store environment (boutique, shopping mall, or website order) is not provided for the participants. The only identifying information of the brand in the image presented to participants is the logotype itself. Country of origin is accounted for in this study because all products were either chosen from industrialized countries or were viewed as neutral.

II. Methods – Participants

A total of 291 Vanderbilt University undergraduate students participated in the study. There were 133 males, 158 females between the ages of 18 and 22. Participants were recruited by undergraduate research assistants. Students participated willingly and were given neither incentives nor rewards for participating in the study.

The Vanderbilt undergraduate student population can be broken down as follows: 4% of the student body is from New England, 14% from the Midwest, 46% from the South, 13% from the middle states, 6% from the West, 8% from the Southwest, and 8% are international students. Although some parts of the country are represented more heavily than others, all
parts of the US are represented in the Vanderbilt student body. The estimated average cost for full-time undergraduate students attending Vanderbilt for the 2007-2008 academic year is $49,834, but 60% of the student body receives some form of financial aid (“VU at a Glance”).

Since this study is about consumers’ perceived value of various brands, the participants were asked to disclose their monthly discretionary budget to see if the amount of discretionary income available to a student impacts their perceptions of the different brand conditions. The average monthly discretionary budget for the participants was $279.63 with a confidence level (95%) of 26.30.

III. Design

A quantitative descriptive research design was used to measure whether or not there is a descriptive difference in the perceived value of one of three brand conditions assigned to identical products as measured by the suggested retail price reported by the participants. From pretests with a smaller population, three products were chosen from three different product categories and three brand names were chosen that would be easily recognizable to Vanderbilt undergraduates. The three products (water bottle, digital camera, and sandals) represent consumable products, electronics, and clothing. These items were chosen because participants could be potential consumers of these items and because they appeal equally to males and females. The three brand levels tested included a no-brand condition with no identifying brand information, Target as a budget brand, and a premium brand. The premium brands chosen were San Pellegrino for the water, Canon for the camera, and Rainbows for the sandals. These brands were chosen because they are well known and easily recognized by college students for the three product categories. Target was chosen as a budget brand that would be likely to sell water, a camera, and sandals, would be easily recognizable, and would sell these products at lower price points than the premium brands.

IV. Procedure

Using Photoshop, high-resolution images of a hand holding a bottle of water, a digital camera, and a sandal were altered so that no identifying brand information such as logos were visible on the images. Then, the selected brand logos (Target, San Pellegrino, Cannon, and Rainbow) were added to the images. The product image remained constant throughout the study with the only change being the brand logotype.

Two hundred ninety-one undergraduate students at Vanderbilt University (133 males, 158 females) filled out a one page survey titled “Retail Survey” (see Appendix A). In the survey, they used self-report measures to provide their monthly discretionary budget and the suggested retail prices for the three items pictured on the survey. Each student was exposed to one picture of a bottle of water, one picture of a camera, and one picture of a sandal. Participants were asked about each product only once to eliminate bias. Twenty-seven
variations of the retail survey were created to randomize the three conditions assigned to the products.

V. Results

An analysis of the research showed that a logotype’s effect differs among males and females and across product categories. The logotypes either added to or took away from consumers’ perceived market value depending on the product and brand condition.

The results from the water show that there was a -6.00% decrease in the perceived value of the water when branded with the Target label and a +33.6% increase when branded as San Pellegrino water. Both males and females showed similar changes when the water was branded as Target water, but women showed a +50% increase in perceived value while men showed a +38% increase in perceived value when branded as San Pellegrino. (Charts illustrating differences between male and female responses are reported in Appendix B.)

Unbranded water was estimated to cost $1.24 (std dev=0.41, median=1.09, mode=1). Target water was estimated to cost $1.16 (std dev=0.40, median=1.00, mode=1.00). San Pellegrino water was estimated to cost $1.66 (std dev=0.89, median=1.50, mode=1.00).
The results from the camera showed a +2.00% increase in the perceived value of the water when branded with the Target label and a +13.50% increase when branded as a Cannon. There was a discrepancy, however, between men and women when the camera was labeled with a Target logotype. Women reported an increase of +2.00% from the perceived value of the unbranded camera when the camera was labeled with a Target logotype. Males, on the other hand, reported a -3.00% decrease in perceived value with the camera was a Target brand camera. (Charts illustrating the differences between the responses of males and females for the camera are reported in Appendix C.)

Overall, the unbranded camera was estimated to cost $166.62 (std dev=97.56, median=150.00, mode=150.00). The Target camera was estimated to cost $170.00 (std dev=90.77, median=155.00, mode=200.00). The Canon camera was estimated to cost $189.16 (std dev=85.69, median=199.00, mode=250.00).

The results from the sandals showed a -31% change in the perceived value of the sandals when branded with the Target logotype and a +18% change when branded with the Rainbow logotype as opposed to an unbranded sandal. Males showed a -12% change in perceived value when branded with the Target logotype while women saw a -42% change. When branded with the Rainbow logotype, males showed a +20% increase in perceived value while women showed a -2.00% change. (Male and female responses for sandals are reported in Appendix D.) Unbranded sandals were estimated to cost $32.30 (std dev=16.55, median=30.00, mode=20.00). Target sandals were estimated to cost $22.27 (std dev=13.86, median=20.00, mode=20.00). Rainbow sandals were estimated to cost $38.21 std dev=19.26, median=40.00, mode=45.00).
The monthly discretionary budget for participants was found to be $239.01 (std error= 13.39, std dev= 277.83, median= 162.36, mode=100.00). (See Chart 1 below). The monthly discretionary income for females is $278.71 (std error=16.52, std dev= 271.34 median=200.00, mode=200.00) with a confidence level of 32.57. The monthly discretionary income for males at Vanderbilt is $280.56 (std error= 21.12, std dev=345.03, median=200.00, mode=100.00).

**Chart 1: Monthly Discretionary Budget Results**

<table>
<thead>
<tr>
<th>Males &amp; Females</th>
<th>Males Only</th>
<th>Females Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>279.63</td>
<td>280.56</td>
</tr>
<tr>
<td>Standard Error</td>
<td>13.39</td>
<td>21.12</td>
</tr>
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<td>Median</td>
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<td>Mode</td>
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<tr>
<td>Standard Deviation</td>
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<td>Count</td>
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<tr>
<td>Confidence Level(95.0%)</td>
<td>26.30</td>
<td>Level(95.0%) 41.58</td>
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</table>
Chart 2. Statistical findings across product categories.

<table>
<thead>
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<th>Camera</th>
<th></th>
<th>Sandals</th>
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<td>High brand</td>
<td>No brand</td>
<td>Low brand</td>
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<td>Mean</td>
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<td>1.16</td>
<td>1.66</td>
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<tr>
<td>Std Dev</td>
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<td>0.40</td>
<td>0.89</td>
<td>97.56</td>
</tr>
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<td>Media n</td>
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<td>Mode</td>
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<td>0</td>
</tr>
<tr>
<td>Base %</td>
<td>100</td>
<td>134</td>
<td>100%</td>
<td>102%</td>
<td>114%</td>
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<tr>
<td>+/-</td>
<td>%</td>
<td>93%</td>
<td>%</td>
<td>100%</td>
<td>%</td>
</tr>
</tbody>
</table>

VI. Discussion

The results of this study show that the general trend for a brand’s perceived value is not consistent across three basic product categories tested (consumables, technology, and clothing). Both water and sandals decreased in perceived value when associated with the budget brand Target and increased in value when associated with the premium brands San Pellegrino and Rainbow. When the results for the sandals are broken down by gender, however, females reported a decrease in perceived value for both Target and Rainbow brands as compared to the unlabeled version of the sandal. When averaged across all participants, the perceived value of the camera increased when associated with both brands Target and Canon. When broken down by gender, however, males reported a decrease in the perceived value when the camera was associated with Target while females reported an increase in the perceived value.

The average monthly disposable income among participants was $279.63. The amount of monthly discretionary income was found to have no correlation on the participant’s perceived value on premium products (See Appendix E).

The products investigated were not perceived as having equal value across brand conditions which highlights the importance of “brand imaging” and “branding” to build value in the minds of consumers. If the results had shown no differences in value for a given object across brand changes the data would have supported that branding does not have a great influence on consumers but that it is the product itself independent of any brand association that holds worth and value.

Since the results showed a change in perceived market value when the logotype changed, the data supports the idea that consumers place value on the brand itself rather than
just the appearance of the product. The results showed a change in perceived value that increased with the association of high quality brand names (San Pellegrino, Cannon, and Rainbow) which illustrates the importance of establishing a desirable brand image to increase the product’s perceived worth.

One reason why digital cameras might experience an increase in perceived value with any brand name association is because consumers do not know how to classify the camera without brand cues and therefore perceive it as less valuable. Also, Target, while not a premium brand, could be a more respected retailer among female college student for electronics than for consumables or apparel and may be a more respected retailer among female college students than male students.

When undesirable brand names diminish the perceived value of the product advertisers should diminish the association between the brand name and product. The water bottle and sandals were perceived to be more valuable when there was no label attached than when they was labeled with the Target logotype. This could imply that marketing initiatives for low-quality brands should strive to market the product independently of the label to increase the perceived market value of the product and be able to charge higher prices.

Such an idea can easily be applied to generic items found in grocery stores. If consumers perceived the generic brand to be less desirable when it is associated with the store name such as “Kroger green beans,” then the store should either disassociate the name from the product or create a new label for the products. This phenomenon has led several retailers to create a new name that alludes to higher quality such as Target’s Archer Farms, Publix Premium, and Kroger’s Naturally Preferred lines to try and build positive perceived worth. The grocery stores hope to increase perceived worth, brand equity, and revenue by attempting to change the store’s name and logo on the food’s label.

VII. Limitations and Implications for Future Research

This study analyzes the influence of a logotype on consumer’s perceived market value of an object. It is important to research consumer’s perceptions for marketing and advertising. The degree to which brands can influence consumer’s perceptions of value could yield valuable information for consumers and businesses alike. This study uses three different products that encompass three different price ranges to try and gain insight into any similarities or differences between different price points and categories. Although this study examines the impact of perceived market value on three items at different price points, as research about the impact of brand perceptions continues to develop it will be important to look in greater depth at the impact of perceived market value on luxury items. The impact of brand image and brand perception may carry different weight in higher end, luxury product categories.

Additionally, this study indicates that technological products are impacted by brand logotypes differently than consumable products and apparel. It would be important to investigate different items such as a computer, calculator, mp3 player or alarm clock to see if
items that fall within the technology category all gain perceived value when associated with a brand as opposed to being unlabeled.

Additionally, in a marketplace where new brands and new names are constantly being introduced to consumers, it would be important to use an unknown brand in the future to provide insight to how consumers evaluate perceived market value for brand with which they are unfamiliar. According to Cordell (1997), the unknown brand condition “has reasonable external validity because consumers are frequently confronted with choices in which some alternatives are unknown brands for which the consumer has no prior knowledge base.”

References


Appendix A

Retail Survey

1) What is your monthly discretionary budget?  $ ______

2) What is your gender?  M   F

3) What do you think the suggested retail prices are for the following three items?

- Bottled Water: $ ______
- Camera: $ ______
- Flip Flop: $ ______
Appendix B

Retail Prices for Water by Gender

Females

![Retail Prices for Water by Gender - Females](image1)

Males

![Retail Prices for Water by Gender - Males](image2)
Appendix C

Retail Prices for Cameras by Gender

Females

```
<table>
<thead>
<tr>
<th>Camera</th>
<th>0.00</th>
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<th>100.00</th>
<th>150.00</th>
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Males

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Appendix D

Retail Prices for Sandals by Gender

Females

Males
No correlation shown between budget and price paid for premium items.
Testing the Use of Whole-part Juxtaposition and Mutual Exclusivity in Preschool Children with Familiar and Non-familiar Objects

Charlotte Agger

Vanderbilt University

1. Summary of the theory and issues

Young children’s rapid acquisition of words and language suggests that they use word learning rules and tools to aid in their fast learning. Recent studies about word learning have proposed that specific principles or tools may be utilized in children’s language learning including the mutual exclusivity principle and the whole-part juxtaposition principle. The theory of mutual exclusivity is the tendency for children to assume that an object can only have one label. For example, a child’s tendency to think that an object such as a soda can is only a can and cannot have any other label. When the tab on the can is pointed to, the child will assume it is a part of the can because the can already has a separate label. This assumption may help children assign meanings to novel words by considering only those meanings and referents for which they do not already have a label. However, the mutual exclusivity assumption serves as just an assumption because it may not always be followed. Some objects do have more than one label.

In addition, whole-part juxtaposing enables children to address novel part terms with familiar object labels. For example, if a researcher points to a bird and says ‘that is a bird’ (familiar object), the research can then say ‘a bird with a beak’ (unfamiliar object) and the child will become familiar with the beak, the unfamiliar object, by recognizing the familiar object and coming to conclusions about each separate part. Juxtaposing novel part terms with familiar whole-object labels provides possible cues to children that refer to something other than the whole object.

Markman and Wachtel (1988) conducted a classic study in which they investigated children’s use of mutual exclusivity in deciphering part labels. The phenomenon of interest was their specific interest in children’s use of mutual exclusivity in deciphering novel parts of given objects. Markman and Wachtel believed that if children adhere to the mutual exclusivity assumption when a familiar whole object term is juxtaposed with a novel part term children will be cued to assume that the novel term is referring to something other than the whole object and must be referring to an alternative part of the whole object. Alternately, Markman and Wachtel thought that the mere juxtaposition between familiar and novel terms may assist in part term acquisition, not only mutual exclusivity. Throughout the study sample, colored pictures were presented to children where the whole object was one color and a distinguished part was a separate color. Children were asked to identify certain parts of the whole object depending on the aim of the question. The independent variables, which
subjects were tested under, were age and specific condition of exposure to whole object label. One condition included a group of children’s exposure to the whole object label before being tested. For example, before being shown a picture of a lung in the testing sequence they were taught the whole object label for a lung before a novel part was introduced, such as a trachea. The second condition children experienced was hearing the whole object label for lung at the same time as they were introduced to the novel part of the lung. Markman and Wachtel measured the dependent variable as whether or not the child gave a correct color, part term response indicating if they adhered to the mutual exclusivity assumption to help them decipher word meaning.

A similar study which expanded on Markman and Wachtel’s alternative hypothesis was conducted by Saylor, Sabbagh, and Baldwin (2002). The phenomenon of interest for Saylor, Sabbagh, and Baldwin was the occurrence that young children can learn new parts of an object through whole-part juxtaposition. These authors were interested in testing whether whole-part juxtaposition better informs children of novel part terms than general cognitive skills and mutual exclusivity alone. The linking hypothesis suggested in the studies of Saylor, Sabbagh, and Baldwin is that whole-part juxtaposition simply enhances children’s retrieval for the name of a whole object and triggers the use of mutual exclusivity in deciphering the part referent for the novel part label. One alternative to the linking hypothesis is that if it is true that whole-part juxtaposition facilitates retrieval, strategies that help lexical access such as delaying the time between the introduction of the whole object term and the novel part term should be just as effective. Another alternative to the Saylor, Sabbagh, and Baldwin hypothesis is that children used structure information to infer a part meaning for the novel term. Upon repeated exposure to whole part juxtaposition and its use for part meaning, children may come to take the grammatical frame itself for part meaning. The independent variables in this experiment were age of subject, condition tested under and animacy/inanimacy of the picture presented. The four conditions used in the study conducted by Saylor, Sabbagh, and Baldwin were the juxtaposition condition, no juxtaposition, delay control, and frame control. In the juxtaposition condition, the child heard a whole object term juxtaposed with a novel part term e.g. ‘See this butterfly? What color is the thorax?’ In the no juxtaposition condition a whole object label was not given prior to the part term e.g. ‘See this object? What color is the thorax?’ The delay and frame conditions were variations of the no juxtaposition and juxtaposition conditions. In the delay condition, the questions were heard as ‘See this? (delay) See it? (delay) What color is the thorax?’ The frame condition posed the question to the child as ‘See this thing? What color is the thorax?’ The dependent variable measured in these tasks was the child’s ability to produce correct color terms for which novel labels were presented. The results of the study conducted by Saylor, Sabbagh and Baldwin give clear evidence that children readily utilize whole-part juxtaposition to interpret novel part terms. Children were better able to interpret a novel label as referring to a part when the novel part label was juxtaposed with a familiar whole-object label than when no juxtaposition was provided.
## 2. Summary of the observational methods

A similar study to the Saylor, Sabbagh, and Baldwin study was conducted on April 3, 2006 at Vanderbilt University Child Care Center in the Stallworth Building on Vanderbilt University Campus in Nashville, Tennessee. Subjects included two 4-year-old males (one Caucasian and one Asian), a 3-year-old Caucasian female and a 4-year-old Caucasian female attending the preschool. The preschool included indoor and outdoor play and learning facilities with teachers and student help. The whole-part juxtaposition and mutual exclusivity study was conducted in the corner of a small classroom. One partner held up pictures while the other one recorded results.

Upon arrival to the child care center I explained our project to the supervising teacher and asked to administer our test to four of the children (preferably 3 and 4-year-olds). Once the teacher had selected four willing and eager students, I played and conversed with each child to familiarize myself with each child. After becoming familiar with the child my partner and I led them to a corner in the classroom to “play a game using colored pictures” and subsequently conducted our whole-part juxtaposition and mutual exclusivity experiment on each child.

To test our interest of the use of whole-part juxtaposition and mutual exclusivity in determining parts of familiar and unfamiliar objects in children, my partner and I assigned each child to a specific condition. We tested whole-part juxtaposition and mutual exclusivity as a tool for part term and whole term meaning. To test this, we recreated tests from Markman and Wachtel in testing mutual exclusivity and from Saylor, Sabbagh, and Baldwin to decipher use of whole-part juxtaposition. No pretest, posttest, or training was administered prior to the experiment. My partner and I utilized four different conditions which dealt with the particular order of what the child was being tested on. In each condition, a child was shown different sets of three separate colored pictures in which the whole object was one color and a singular part of the object was another. Colors used in the pictures were intended to be familiar: red, blue, green, yellow, orange, and purple (one picture included silver). Children were asked to identify the color of the part being referred to. In the primary condition in the mutual exclusivity task child was shown a familiar whole object with an unfamiliar part and asked to identify the color of the unfamiliar part e.g. When shown a picture of a cow asked, ‘What color is the muzzle?’ The second condition involved unfamiliar whole objects with unfamiliar parts. The child was shown a new set of pictures and questioned the same way as in the previous condition. The unfamiliar whole objects with unfamiliar parts were neuron and nucleus, padlock and dial, lung and trachea. The following two conditions dealt with the whole-part juxtaposition theories of our study. The third condition assigned to subjects utilized whole-part juxtaposition in questioning the child about part term labels. The child was shown a new set of pictures and questioned in a manner where the whole object part was given and a novel part was introduced shortly after e.g. ‘See this fish? What color is the dorsal?’ The final condition employed did not use whole part juxtaposition and a whole object label was not introduced before the novel part term was heard e.g. ‘See this? What color is the dorsal?’ Four sets of pictures were used in this study:
Set 1. Cow and muzzle, sailboat and mast, truck and plough.
Set 3. Fish and dorsal, flower and stamen, elephant and tusks.
Set 4. Butterfly and thorax, shoe and tread, train and coupler.

In order to control for order-effects we altered the order of mutual exclusivity and whole-part juxtaposition tasks and also the order of pictures sets were shown for each task.

In recording and measuring our responses for each condition a child was given a score of 0 if he or she did not correctly identify the color part and a score of 1 was given for correct color part identification. A correct response is defined as providing the correct color in response to the part referent.

3. Results

<table>
<thead>
<tr>
<th>Mutual Exclusivity Familiar</th>
<th>Child #1 Response</th>
<th>Child #2 Response</th>
<th>Child #3 Response</th>
<th>Child #4 Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>cow with a muzzle</td>
<td>orange-0</td>
<td>red-0</td>
<td>red-0</td>
<td>blue-1</td>
</tr>
<tr>
<td>truck with a plough</td>
<td>green-0</td>
<td>green-0</td>
<td>green-0</td>
<td>yellow-1</td>
</tr>
<tr>
<td>sailboat with a mast</td>
<td>red-0</td>
<td>red-0</td>
<td>red-0</td>
<td>red-1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mutual Exclusivity Unfamiliar</th>
<th>Child #1 Response</th>
<th>Child #2 Response</th>
<th>Child #3 Response</th>
<th>Child #4 Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>neuron with a nucleus</td>
<td>green-0</td>
<td>green-0</td>
<td>green-0</td>
<td>orange-1</td>
</tr>
<tr>
<td>padlock with a dial</td>
<td>blue-1</td>
<td>blue-1</td>
<td>silver-0</td>
<td>blue-1</td>
</tr>
<tr>
<td>lungs with a trachea</td>
<td>red-0</td>
<td>red-0</td>
<td>red-0</td>
<td>red-0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Whole-Part Juxtaposition</th>
<th>Child #1 Response</th>
<th>Child #2 Response</th>
<th>Child #3 Response</th>
<th>Child #4 Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>fish with a dorsal</td>
<td>green-1</td>
<td>yellow-0</td>
<td>green-1</td>
<td>green-1</td>
</tr>
<tr>
<td>flower with a stamen</td>
<td>green-0</td>
<td>green-0</td>
<td>green-0</td>
<td>yellow-1</td>
</tr>
<tr>
<td>elephant with tusks</td>
<td>purple-0</td>
<td>purple-0</td>
<td>red-1</td>
<td>red-1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Without Whole-Part Juxt.</th>
<th>Child #1 Response</th>
<th>Child #2 Response</th>
<th>Child #3 Response</th>
<th>Child #4 Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>butterfly with a thorax</td>
<td>purple-0</td>
<td>pink-0</td>
<td>black-0</td>
<td>purple-0</td>
</tr>
<tr>
<td>shoe with tread</td>
<td>green-1</td>
<td>purple-0</td>
<td>purple-0</td>
<td>green-0</td>
</tr>
<tr>
<td>trains with a coupler</td>
<td>red-0</td>
<td>red-0</td>
<td>red-0</td>
<td>red-0</td>
</tr>
</tbody>
</table>

correct response=1
incorrect response=0

4. Evaluation

Our observations included many findings of particular interest. In analyzing the results of the tasks, we first focused on the tasks of mutual exclusivity and whole-part juxtaposition in isolation from one another. In the task of mutual exclusivity with familiar whole objects, there were three total correct responses. In the unfamiliar condition there were four total correct responses. These findings do not give a clear indication of whether or not children
use the principles of mutual exclusivity in identifying objects because similar number were gathered (3 and 4) for the mutual exclusivity and non-mutual exclusivity conditions. A higher number in the familiar condition would indicate that children use mutual exclusivity in using part term labels. Also, the correct responses in both the familiar and unfamiliar conditions were practically equal.

Our results do not fit with the results achieved in the classic study by Markman and Wachtel since they concluded that children do use the principle of mutual exclusivity in learning part term objects. Markman and Wachtel concluded that children do use mutual exclusivity because children were more likely to respond if the familiar object label was given before the novel part was given. More specifically, our results may have been skewed and further do not fit with the classic study of Markman and Wachtel because we did not teach the children the word meanings prior to the experiment as Markman and Wachtel did. We may have gathered more consistent results if we had ensured exposure to these whole object labels by doing a previous teaching of the labels before the experiment. The children probably did not understand some of the objects being presented and were therefore confused by the questions and procedure. Our results may have also been skewed because children may have had a bias towards a certain color or object, such as the color ‘red’ or the object ‘cow.’ This may have manipulated the way that the experimenter’s questions were answered due to certain preferences or inclinations held by the children. Children may have preferred a certain color or had a previous experience with a certain color that created biases within their thinking.

Our results did, however, fit with the whole-part juxtaposition linking hypothesis of Saylor, Sabbagh, and Baldwin. More specifically, there were six correct responses in the whole-part juxtaposition condition verses only one correct response in the without whole-part juxtaposition condition. This indicates that children learn part term labels better when presented with the whole object label and the novel part term are juxtaposed (placed side by side). Children were more likely to respond correctly when whole object labels are presently juxtaposed to novel part terms.

As an interesting spin which was not included in the classic or contemporary study, we decided to combine both studies and compared children’s ability to learn part term labels using mutual exclusivity verses uses whole-part juxtaposition. We found that children had more correct responses in whole-part juxtaposition task than in the mutual exclusivity task. We recorded only three correct responses in the familiar mutual exclusivity task verses six correct responses in the whole-part juxtaposition task, which indicates that children are more likely to respond correctly when whole-part juxtaposition is used. These results may further indicate that children use pragmatics as opposed to using constraints when learning part term labels in language since mutual exclusivity is a tool of constraints and whole-part juxtaposition utilizes pragmatics. However, our results may have been skewed due to a child’s affinity for or knowledge of certain pictures. The children tested may have had an affinity for certain pictures or colors due to past experiences and practices during upbringing. For example, one child may have had a certain bias towards cows and had existing knowledge of the term ‘muzzle’ if he or she was raised on a farm.
In conclusion, our results were not consistent with Markman and Wachtel but were coherent with the linking hypothesis presented in the study by Saylor, Sabbagh, and Baldwin. We successfully demonstrated in our study that pragmatics play a crucial role in the development of children’s language, as they may use whole-part juxtaposition more often than mutual exclusivity to learn part term labels with and without novel objects. These findings provide testament to children’s ability to go beyond the obvious to draw inferences about speakers’ referential intentions, which greatly aid in language learning. Future studies may explore the advantages of using these two tools of constraints and pragmatics with familiar and unfamiliar objects in children’s language development and learning.

References


Fluid Learning

Jordan Barnes

Cognitive Science

Simon Fraser University

Abstract

This paper attempts to clarify some of the challenges associated with high-level learning and provide a context for future research directions in this area. A moderate to advanced level of familiarity with the fluid-analogy systems developed by Douglas Hofstadter and his team of researchers at Indiana University is presupposed. These are models of cognition and perception that are characterized by their use of analogies and distributed agents to solve problems. Fluid-analogy systems like Metacat (Marshall, 1999) and Letter Spirit (McGraw, 1992; Rehling, 2001) have received distinguished interest in Cognitive Science for their unique and psychologically plausible approaches. It is with the contributions of these systems in mind that a serious discussion about the obstacles and directions for a comprehensive theory of learning can begin to be fleshed out.

Introduction

Dampening the wider acceptance of fluid-analogy systems in Cognitive Science, is the difficulty posed in explaining how these systems might be used to learn new concepts. Learning is central to what the mind does, and as such, complex structured systems that make vague claims about learning are easily, and perhaps rightly, viewed as being out of step with the practical problems of the field. This being said, many interesting learning mechanisms already exist within most fluid-analogy systems. Metacat in particular, is endowed with several sub-systems that allow processing runs to be stored and used as influence in future or ongoing workspace activity. Further to this, a good argument can be made that fluid-analogy systems require a functioning working memory, and by virtue of this fact, are learning how to appropriately represent a given problem or percept within this working memory.

The problem is that the learning that underlies these memory systems is, at present, restricted to the specific domain for which the program was created. This has been a longstanding criticism of fluid-analogy models (Forbus et al, 1998), and one that researchers (Michael Roberts, 2001) at the Center for Research on Concepts and Cognition (CRCC) have indicated that they are working to address. At issue with respect to learning are two critical points. A concept, such as the abstract notion of the crossbar in the letter "t", must be learnable if a system like Letter Spirit is to have any kind of automated extensibility. Letter Spirit currently requires hand-tailored descriptions for its role concepts, which are developed
from a combination of statistics and human intuition (Hofstadter et al, 1995). Additionally, learned concepts must have properties that make them domain independent. In other words, what properties does the crossbar concept share with other objects in the world that would allow someone to make it look 'electronic', 'medieval', or 'mountainous'? It is not at all clear what level of analysis is needed for these questions but looking at the problem from a low-level point of view as well as discussing general concept learning seems like the only appropriate way to begin.

For a problem as complex as bridging the gap between low-level, neurobiologically plausible learning, and high-level structured concept learning, two simultaneous research programs are needed. One stream of thought should be devoted to expanding on methods of developing abstract, "role" based, connectionist representations for objects and problems. This kind of work was advanced in a significant way by Douglas Blank in his Analogator (1997) neural networks. These experiments show how simple, abstract representations, for things like the parts of letters (or 'roles' in the terminology of Letter Spirit), can be learned in very basic analogical situations. This work appears to be under-appreciated in Cognitive Science, given that Analogator has provided an interesting way of developing genuinely structure sensitive representations that could be useful in a variety of circumstances. The research potential in this area is wide-open and an example of what can be done with this work is detailed here. The other stream of thought should focus on how fluid-analogy systems can be integrated, such that they can share their individual talents and fill-out, in rich detail, the attributes of learned concepts. This is an immensely complex task, and one that will only be foreshadowed here.

"[N]aive approaches that assume that backpropagation (or some similar algorithm) will cause roles to emerge in very simple three-layer networks without specific training subtasks which, if well-designed, might force the system to process roles or without specific architectural features (which likewise might force a network to process roles) is misguided."
- Gary McGraw (pp. 359)

The roles that Gary McGraw refers to in the above quote have to be learned somehow. The discussion here is about what a well-designed system that forces a network to process roles would have to look like. A good first step to understanding the scope of the problem of role-learning would be to work with the learning system that has so far yielded the best results in this domain, Analogator, and see what it can do in terms of discovering roles as opposed to just identifying them.

Analogator's training procedure works as follows. Roles like the kind pictured below in the letter "b" are supplied to a standard backpropagation neural network.
Two instances of the letter "b" broken down in to its constituent abstract parts of left-post and right-bowl.

One input bank of the network might accept the right-bowl, and the other would accept the entire letter. Blank refers to the right-bowl in this case, as the "figure". There is one hidden layer and two output banks. The first output bank would be trained through backpropagation to identify the figure and the second would be trained to identify what would be the left-post in this case, or the "ground". Once the network has had sufficient training iterations to identify each piece, the activations of the hidden layer are passed along with a new "b" in a different typeface, as the input to a new network. This network is again trained to dissociate the figure and ground of this new "b", in effect, learning the abstract similarities between the figure and grounds in both letters. This process is repeated many hundreds of times until Analogator is able to identify the figure and ground components for a "b" it has never seen.

Importantly, Analogator has not discovered the abstract roles in the letter "b" on its own. It was a human that decided how a "b" should be broken up, and a human that decided where the breaking point is in all of the training examples. This does not address what McGraw is getting at when he says that backpropagation networks are unlikely to learn new roles. What Analogator needs to be trained to do is discover what the roles are for a letter it has never seen before. This is a much trickier task. To see if there are such a thing as analogous roles in different letters, that can be discovered by a network of this type, Analogator should be trained on questions of the form: 'What is the "|" of "d", in "p" or 'what is the "c" of "d" in "b". The hope is that the abstract roles of the ascender left-post or right-bowl may be learned as a principle of letter construction in general.

The Analogator Role Learning Procedure

1. Provide the letter "d" in the source scene.
2. Backpropagate the ascender bar as the figure and the bowl or closure as the ground.
3. In a new network, provide the letter "b" with the hidden layer from step 1 as input.
4. Backpropagate the ascender bar as the figure and bowl as the ground.

5. Train on a variety of typefaces, with several different letter combinations such as "b" and "d", "m" and "w", and "z" and "n".

6. Measure the success of the network in parsing a variety of different "p" styles in to parts that correspond to its abstract role categories.

A successful identification should be evidence that the network was able to learn roles for a new category of letter without exposure to it. Of course the problem of how the seed roles were learned is an open question, but one that can be addressed at a later time should the procedure prove successful.

The results of this investigation are not yet conclusive or ready for publication. For reasons that will be elaborated on in the coming discussion, I am skeptical that this approach can possibly have a very high degree of accuracy. The way people develop and use letters seems to be sensitive to all kinds of cultural and instrumental nuances that are beyond the scope of this simple kind of analogy making. At best it seems that the network may learn some rather arbitrary type-design rules about using one letter as inspiration for another. Nevertheless, this approach should be exhausted, as something akin, but likely much more complex, must be taking place in some way in our minds. Before a discussion about high-level learning can take place in earnest, there must be a closer look at some seemingly unrelated issues in high-level perception research. Without being able to presuppose some significant advancements in fluid-analogy architectures, high-level learning really isn't possible. To this end, I will be looking at some of the integration and improvements that will need to take place before detailing a theory of high-level learning.

**Letter Spirit is not good at recognizing "thickness"**

Letter Spirit does not fare well at all with "bubble" letters or "thick" parts. Metacat however, has a potential solution to this limitation. Instances of concepts and relationships can be linked to their cardinality in Metacat's Slipnet. For instance, three "E"'s in a row would first be individually labeled by 1-Group codelets, then a neighboring pair might get a 2-Group label and finally a 3-Group codelet might bond them all together. Codelets designed to discover groups permeate the workspace allowing for the re-application of concepts like "successor" to higher-order groups. For example the problem "ABC --> ABD; QBBTTT --> ?" is solvable in Metacat by allowing codelets to discover the relation between letter successorship and numerical successorship of groups. A likely answer from Metacat to the problem posed might be "QBBTTTT" (which relies on seeing QBBTTT as a 1,2,3 group). Grouping is the concept needed to understand "thickness" in Letter Spirit. Consider these two letters:
An "o" and an "l", composed of lower-level groups of o's and l's.

By grouping the "o"s together and reapplying the same codelets used in the identification of the low-level "o"s, the high-level figure emerges. Analogously, a standing rectangle can also be seen as a 2-Group of ascenders in the right circumstances.¹

Letter Spirit is unable to see a style involving a sequence over several letters

Not all of the elements of style in a particular typeface are intrinsic to isolated letters within that typeface. What this means is that a stylistic pattern may emerge at a higher-level than the themes contained in individual letters themselves. One could imagine a typeface designed to be taller and taller as letters approach the middle of the alphabet and then shorter and shorter as they approach the end.²

```plaintext
abcdefgijklmnopqrstuvwxyz
A typeface that grows and shrinks.
```

Clearly this is an extrinsic pressure on the style of the alphabet that requires knowledge of the alphabet's successorship relations, and a concept for middle. There is no way Letter Spirit could currently perceive a pattern like this and it does not come up as a topic of discussion in any of the work done on the program.

Metacat's concepts should be graded

Metacat can also be improved by incorporating aspects of Letter Spirit. Metacat should

¹ The assessment of the "right" circumstances gets complicated but the point remains that Letter Spirit's role model could benefit from the use of a concept like successorship.
² Referring to immutable, a priori information
have varying degrees of relational activation. The cleanness of problem solving in Metacat is a luxury of having "Platonic"³ (Hofstadter, 1995) concepts. "B" is the predecessor of "C" and "C" is the successor of "B". These relationships are explicitly coded in to Metacat and are either true or false. The relation itself can not reflect the strength to which those objects may or may not activate their respective categories. Letter Spirit's self-determined confidence in its classifications are a natural fit for influencing the degree to which Metacat should pursue a particular path of processing in a given letter string analogy problem.

A Gestalt-Driven, High-Level, Learning Hypothesis

From a high-level standpoint, the system would work by grouping information together at every level that it can and then refining those groupings over time with feedback from the environment. Said in this way, this theoretical architecture doesn't sound much different than any other common sense view about learning. What makes it unique are the specific details regarding hybridization of existing fluid-analogy systems, in order to bootstrap concepts from one level to the next and how to appropriately store and retrieve items from memory.

Methods

Stimuli to be learned would be provided on a grid meant to be a kind of retinotopic map. Activated points (or quanta, to borrow the term from Letter Spirit) on the map would initially be chunked together into groups based on very coarse sensory discriminations such as color, distance, and connection (Wertheimer, 1938). The topology of these chunkings would be used to try and activate any Gestalts that may have similar topologies, in precisely the same way as it is done in Letter Spirit.⁴ If no gestalts are adequately activated to provide top-down biasing, the chunk may be held with temporary activation in something like an iconic memory store. Pressure would mount to re-parse the chunk, which may result in a separate stream of processing spawning two worlds of possibilities⁵ with varying interpretations about the nature of the chunks in the workspace.⁶

³ Referring to immutable, a priori information
⁴ Rehling (pp. 168) describes Gestalt activity in Letter Spirit this way: "An Examiner run begins with the segmentation of the gridletter into parts ... The Coderack is then initialized with one Gestalt codelet, which looks for hints about the possible letter category of the gridletter, and, for each part in the segmentation, two looker codelets, which begin the process of identifying what roles the parts may be fillers of [sic]."
⁵ The language here would seem to invoke ideas from Dennett's Multiple Drafts Theory of the mind (1991). In this theory, people may have several competing versions of reality being argued for and compositionally spliced together in a continuous flow of thought.
⁶ This kind of parallelism would have to be very carefully constructed however. Allowing new worlds of thought based on every interpretation and reinterpretation of parts could easily end up being combinatorially explosive; as was suggested of Hearsay II's parallelism (McGraw, ibid). I don't pretend to know how to solve this difficulty without first having a model to try different approaches with.
Gestalt codelets corresponding to the topologies of all the different chunks in the workspace would be, at a very minimum, placed in some kind of iconic memory with connections to the other chunks that were developed contemporaneously. It is very important that every chunk in the workspace gets a gestalt codelet with descriptions about its shape, use and context, even if it is never seen or used again. Whether or not a Gestalt codelet gets placed in longer term memory depends on whether or not it gets used and how relevant that use was to the processing of the scene in general. These kinds of abstractions have been shown to be possible as in the case of Metacat's self-determined assessments about critical events in the course of its processing, which build up the contents of the temporal trace and episodic memory. Gestalt codelets are to be thought of as cheap and expendable in this model. Most of what we see only needs to be remembered at the highest levels and without focused attention, unused gestalt codelets should simply be discarded after a brief period of time, in order to clear up processing resources. Evidence for this assumption can be found in work done by Kikuno and Haruo (1991), who showed that people have terrible memories for features that exist at levels lower than what is normally needed for classification, as in the case with the features of everyday coins.

Chunks that do activate existing gestalt codelets, whether in some kind of iconic or longer term memory, would begin to bias the processing similarly to how it is done in Letter Spirit. Perhaps the chunk activates a simple closure, or a more complex figure. Whatever the case may be, these activations initiate top-down processes that begin to terrace the processing landscape in favour of certain pathways over others. These pathways may affect the course of attention over time and unrecognized gestalts may experience pressure to reorganize their parsings in a new way, or they may become the locus of attention because of their poor fit, or both may happen simultaneously in competitive interpretations.

Where this process begins to diverge from Letter Spirit is when chunks are also given inter-chunk relations in something like Metacat's Sipnet. Overlaying concepts from the Slipnet with grid information from Letter Spirit's conceptual network in the same workspace makes inter-domain spreading activation possible.

In the previously discussed example of the growing and shrinking alphabet, the concepts of alphabetic-successorship and increasing-relative-size, would need to be connected together in order to form a high-level theme. At least for the first half of the alphabet. It is not entirely clear however, how the concept of "increasing" can be represented over the concepts currently in use in Letter Spirit. There is no concept called "taller" for instance, that would allow Letter Spirit to translate zone information relationally. This is an indication that the concepts used to describe the grid in Letter Spirit are not in fact primitives. They are labels for more fundamental sets of relations that have not yet been described but would have to be in order to make the system truly general.

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7 At least for the first half of the alphabet
If this is a little unclear, the concept of "tall" in this case should be thought of as a certain group length of successor relations relative to everything else in the grid. There are two advantages to describing areas of the grid in these terms. One is that the concept of "taller" in the example has an actual meaning. It is the successor of a certain magnitude of other successors along the vertical dimension. A potentially useful idea for converting Letter Spirit's norms into sets of more primitive descriptions is to think of everything as being relative: tall is tall, relative to other members of the same kind of category. The second advantage of this terminology is that it becomes yet another topology of the concept upon
which analogies can be seen between domains.

Another subset of examples: this time of conceptual connections using pairwise connections between some of the nodes from Letter Sprit's grid and their slipnet relations.

In "To Seek Whence Cometh a Sequence", Hofstadter (1995) provides sequences of numbers for what he calls a "mountain-chain" (pp. 57). If the y-coordinates <1,2,3,4,5,4,4,3,2,1> are plotted in succession over the x-axis you get a pattern that looks similar to a mountain with a peak and a plateau. Similarly, a norm description in these numeric terms would look something like this for the letter "v":

<9,8,7,6,5,4,3,2,1,2,3,4,5,6,7,8,9>
or in successorship terms:  
\[
<s(s(s(s(x)))), s(s(s(x)))), s(s(x)), x, s(x), s(s(x))), s(s(s(x))))>,
\]

What this provides is a neutral way of describing objects such that relationships between them can be identified at higher-levels of perception and \textit{inter-domain} similarities discovered by virtue of the descriptions of other concepts in the same terms. Earlier in this paper, it was asked how you might describe a part of a letter such that it could be considered "mountainous". Domain neutral, topological descriptions are the way to do it.

An entangled hierarchy involving the machinery of fluid-analogy systems like Letter Spirit and Metacat, could form the basis for shifting levels of abstraction from quanta to parts to roles to wholes to parts to roles to wholes \textit{ad infinitum}, until a representation is understood for what it truly is in context. Learning then, is the storage in memory of those chunks or gestalts that contributed to a higher-level picture, along with how they were used. Groups and their contextual relations become the roles or \textit{active concepts} through which semantics are constructed. Their existence is necessitated by the whole they became a part of, and by the gestalt that was created for that whole. It is a role \textit{hypothesis} because their validity is relative. Should the role cease being useful in its current form, it can change or be discarded over time.

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\footnote{s(x) being the Peano notation for "successor of x".}

\footnote{\textit{Active concepts} is a term coined to describe references that are not merely empty symbols that get shunted around in a computer, but animate and dynamic processes that contribute to a non-deterministic semantics.}
Development

Of course, this model is only a rough approximation of an actual implementation. It is meant to pump the intuitions of those interested in learning. The kinds of codelets, their parameters and the precise structure of the system would all have to be tweaked over hundreds if not thousands of trials, mirroring the development of the other fluid-analogy models. Although it may not be achievable in full at the moment because of processing constraints, an idealized learning system of this type is very much a possibility.

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Readers interested in these ideas may find the recently published dissertation of Harry Foundalis (2006) entitled "Phaeaco", to be a much more articulated and complete vision for fluid learning and cognition. I was only made aware of this work after finishing this paper - unfortunate, given its high degree of relevance.
Can Neuroscience Inform the Free Will Debate?

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Armchair philosophers, professional philosophers and even reluctant, first-year students in introductory philosophy classes have all been drawn in by the tremendously interesting and equally frightening question: *Do we have free will?* Some find solace in Cartesian dualism,¹ but the rest of us monists² are left to grapple with the inconsistency between our intuitive feeling that we are free to make our own decisions and the knowledge that our minds operate within what science assumes to be a deterministic universe. For millennia, this question has been approached theoretically, but new neuroscientific findings may give researchers the ability to broach the subject experimentally. The discussion has not just moved from the salon to the laboratory, but also to the newsroom, where lay press articles have been cropping up with ominous titles like “Free Will: Now You Have It, Now You Don’t” (Overbye, 2007), “The Brain on the Stand” (Rosen, 2007), and “Case Closed on Free Will?” (Youngsteadt, 2008). Undoubtedly, the revived academic and public interest in this age-old debate stems from the profound moral and legal implications that rest on the idea that humans have free will.

This paper seeks to establish whether or not the new findings can, in fact, inform the free will debate and, if so, what that means for society’s conceptions of moral and legal responsibility. The first section draws the battle lines by explaining both sides of the debate and defining the terms that will be used for the remainder of the paper. The second section takes up the question of neuroscience’s ability to weigh in on the dispute, and the third addresses the possible moral and legal ramifications.

**Section 1: Free will, Determinism and Compatibilism**

The standard free will debate has been framed as incompatibilist—either the world is deterministic, precluding free will (as so-called “hard determinists” believe), or it is not, and

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¹ Rene Descartes proposed that the mind and body are made of separate but interacting substances. Because the mind is a non-physical substance, it is not subject to the physical laws that govern the rest of the world (and, therefore, its actions are not governed by deterministic principles). Due to this separation, dualists can believe in both determinism and free will, escaping the debate all together.

² Monists believe that the world is comprised of only one substance—a physical substance, in the case of materialists—as opposed to separate substances for mind and body.
free will is possible (as “libertarians”\textsuperscript{3} would argue). In other words, free will and determinism have been pitted against each other as mutually exclusive opposites. Others (aptly referred to as “compatibilists”) disagree and see free will and determinism as entirely compatible.

I argue that free will and determinism are tightly interwoven concepts, albeit not necessarily opposites. Pulling their meanings apart from one another can be helpful in deciding if and how neuroscientific research is relevant to the free will debate. Further, I contend that modern compatibilist arguments are flawed, and that free will (as we intuitively think of it) cannot exist in a determined world.

\textit{Determinism}

Determinism has been defined as the idea that every event is caused by an antecedent event and governed by the laws of nature (Van Inwagen, 1982). The opposite of determinism, then, would be a belief that every event is uncaused and is \textit{not} governed by the laws of nature. In other words, chaos or randomness (not free will!) is the opposite of determinism. Determinism is best conceptualized as a spectrum with determinism on one side, chaos on the other, and different degrees to which events follow laws and causal relationships in between.

While it is very uncomfortable to think that all of our decisions are determined by events set into motion millions of years ago and that it is not really the “self” who is in charge, it may be even more uncomfortable to think of our decisions as \textit{undetermined}. As many philosophers have pointed out (Churchland, 2004; Dennett, 1984; Hume, 1739; Wegner, 2002;), no one would be happy if her decisions were entirely random—unrelated to her beliefs, desires and temperament; we would not think of these decisions as being “free,” any more than we would events that were entirely determined by physical laws. Note that this is not good news for the libertarian argument, which holds that free will can exist because determinism is false.

In addition to the fact that indeterminism is no more satisfying than determinism for either side of the argument, it also lacks any form of evidentiary support. There is ample evidence pointing to determinism, however—each time we drop a pencil and it falls to the ground with an acceleration of 9.8 meters per second, we are confirming that events in the world operate according to unchanging laws—in this case, the laws of gravity. Each time we put a pot of water on the stove to boil, we are implicitly relying on the deterministic principles of cause and effect: the heat causes the hydrogen and oxygen molecules to move at a faster pace. Quantum theorists will be quick to note the inherent unpredictability of subatomic particles, but few would challenge the claim that the world can still be described as operating within a system of laws. The chance that these “laws” of nature might not accurately predict the state of the world is infinitesimally small and can effectively be thought of as zero. Thus, while the world might not fall on the \textit{exact end} of the determined

\textsuperscript{3} The term “libertarian” is used here separately from its definition in political philosophy.
side of the spectrum, as far as our current scientific knowledge can tell, it is almost indistinguishably close to it.

**Free Will**

Unfortunately, it seems that our common sense notion of free will is flawed regardless of one’s opinion on determinism: free will is impossible in a world that is determined (so that our choices are made for us by the laws of physics, cause, and effect), undetermined (so that our choices are selected randomly without relation to our goals and opinions), or anywhere in between (so that some of our choices are determined by laws and some of them selected randomly). Intuitively, we think of free will as our ability to choose whether or not and how to act. However, in the context of the current discussion, that seems like an unrealistic expectation. What we are *really* referring to (or, at least, should be) when we talk about free will is the extent to which we *feel* that we are in control of our decisions and actions. For example, one would feel freer if she indulged in a chocolate ice cream cone because she were craving chocolate than if she did so because someone held a gun to her head and ordered her to lick or die. As with determinism, it is helpful to think of free will as existing on a continuum (although a separate one), with the feeling of free will on one end and the feeling of complete constraint, or to put it in legal terms, compulsion, on the other (i.e., the gun-to-the-head scenario). We spend most of our time, I would wager, near the “feeling of free will” side, with occasional constraints (i.e., my doctor said I shouldn’t eat sweets; I’m too tired to go to the ice cream parlor) pushing us in the opposite direction. In other words, free will is the *perception* of freedom by agents acting in the world.

I say perception, because we may not (and probably do not) have an accurate understanding of the extent to which we are constrained and probably overestimate the amount of autonomy we actually exercise. Although we feel a qualitative difference between eating chocolate ice cream because it tastes good and being forced to do so under the threat of death, that difference may be illusory—especially given what we know about determinism and indeterminism. If we assume that we are living in a deterministic universe, and that *all* of our actions are caused, then we are under an equal amount of compelling force in both cases (the craving vs. the gun). If we assume that we are living in an *ind*eterministic universe, the compelling forces are still equal: equally random. Any assumption in the middle of the spectrum would be similarly unfulfilling.

The distinction we sense between the gun and the craving comes from the differential saliency of the compelling forces. This, I argue, is at the root of what makes us feel as though we have free will; we feel that we are free when we are unaware of the compelling forces at work (because they are subtle and, in many cases, unknown), and we feel that we are less free when we are aware of the compelling forces, as when we are staring down the barrel of a shot gun. One could empirically test this hypothesis by having participants read multiple scenarios in which people make decisions based on compelling forces that vary in saliency. Participants would rate how “free” the person is in each scenario. I predict that their freedom ratings would decrease as the saliency of the compelling forces increased.
Compatibilism

Given this new, proposed definition of free will, let us consider compatibilist arguments. As mentioned earlier, compatibilists believe that it is plausible for us to have a meaningful kind of free will in a deterministic universe. Although compatibilist arguments vary, a particularly helpful summary by Gifford (2007) characterizes the most common, modern compatibilist argument as follows:

Compatibilists hold that free will exists as long as the agent is not subject to outside coercion. As long as our actions are a product of our own reasons for taking those actions, as long as they spring from our personal beliefs and preferences, even though those reasons, beliefs, and preferences are a product of a deterministic universe, we have free will. (p. 273)

When compatibilists admit that the “reasons, beliefs, and preferences are a product of a deterministic universe,” they are essentially agreeing with my contention that we are always under the influence of compelling forces. However, they claim that we have free will “as long as the agent is not subject to outside coercion.” These two statements are contradictory. As I have demonstrated, regardless of whether the world is determined, undetermined, or anywhere in between, we are always subject to outside coercion; we just feel that we are not when the forces that are compelling us are unknown or lack saliency. It seems that the compatibilists fall prey to this ever-convincing illusion. Their argument could be accurately restated as such: one is free as long as the compelling forces that are motivating her decisions are not salient, e.g. we are free when we feel that we are free. As persuasive as our feelings of free will may be, they are illusory, and feeling that we are in control of our decisions and actions is not the same as actually being in control.

Unfortunately, as Greene and Cohen (2004) pointed out, there is no way around the fact that intuitive free will is inherently libertarian, not compatibilist. And as we have seen, libertarian doctrine does not stand up to the test of science. Thus, with both libertarianism and compatibilism knocked out of the running, we are left with hard determinism and a diminished form of illusory free will.

Section II: Can Neuroscience Inform the Free Will Debate?

Since it has been established that determinism and free will are actually separate (though related) issues, I will consider neuroscience’s relevance to them individually. I have also demonstrated that libertarian and compatibilist arguments leave much to be desired. Even so, many people still cling to libertarian and compatibilist philosophies. Let us examine how neuroscience can add to the free will debate.
Determinism

As discussed earlier, although most of the scientific community agrees that the world is deterministic, the consensus is not unanimous, and there is even more contention about the matter outside of the field. Despite decades of research (and, for those of us who have not witnessed miracles, personal experience) all pointing to the conclusion that every event has a cause and operates according to unchanging, physical laws, some are still left unconvinced. This is not entirely surprising considering how distinctly “ours” the decisions we make seem. While neuroscience cannot prove that determinism is true anymore than previous research has, it can lend some pretty convincing supporting evidence.

I hypothesize that neuroscience’s specific brand of evidence will be even more persuasive—especially to the lay public—than previous research has been, because it deals not with the theory of relativity or the continued accuracy of the laws of gravity or thermodynamics, but with the very seat of the human mind. For centuries, it has been easy to put the mind up on a pedestal and claim that it operates by fundamentally different rules from the rest of the world. But if the days of acceptance for Descartes’ proposed “animal spirits” and other similar types of sloppy metaphysics have not yet passed, they are now in their final hoorah. With functional neuroimaging and other emerging neurotechnologies, we are now capable of opening the black box of the brain and peering in, at least to a greater extent than ever before—an ability that will shake the brain’s pedestal, if not knock it down entirely.

Although neuroscience cannot revolutionize the free will vs. determinism argument itself, it may revolutionize the way people think about it, as experimental evidence hits closer and closer to home.

For example, by utilizing functional magnetic resonance imaging (fMRI), researchers are able to observe which areas of the brain are active as participants engage in experimental tasks. In one study by Greene, Nystrom, Engell, Darley, and Cohen (2004), participants were scanned while making difficult moral decisions. Greene and his colleagues found that the neural activation varied systematically depending on whether the dilemma was of a personal or impersonal nature. Additionally, depending on the relative activation of the brain centers associated with “cognitive” and “emotional” processing, one could make relatively accurate predictions as to how the participants would respond to the questions being posed. Another experiment by Huettel, Stowe, Gordon, Warner, and Platt (2006) found that differential levels of activation within the lateral prefrontal cortex during a gambling task could predict participants’ preferences for risk taking and general behavioral impulsiveness.

Looking at studies like these, it seems evident that the neural activations researchers are detecting have a causal relationship with the behavior being observed. It also seems clear that it is not an immaterial “soul” that is at work during the decision-making processes, but a very material brain. Furthermore, it is hard to imagine a task that would be more under the “soul’s” jurisdiction than solving a moral dilemma. If the brain is at work solving even this most sacred problem, chances are good (and research points to the conclusion) that the brain

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4 Descartes proposed that the brain contained “animal spirits” which allowed the mind and the brain to communicate by passing through the pineal gland.
is, in fact, in charge of all of our cognitive functions. As these and other studies suggest increasingly mechanistic views of the way the brain works, it is becoming harder and harder to deny that it operates according to the same physical laws as the rest of the universe. As new neuroscientific knowledge pushes conclusions toward the determinism end of the determinism vs. chaos spectrum, we inevitably think about what this means for the free will vs. constraint spectrum. Let us consider how these findings may affect our perceptions of free will.

Free Will

Earlier, I defined free will as a subjective feeling, which depends on the extent to which the actor feels that her choices are constrained by “outside” forces. I hypothesized that it is the saliency of the compelling forces that affects one’s feeling of freedom, with less obvious determinants leading to lesser feelings of constraint. For instance, it is now clear that our genetics and the environment in which we grew up play large roles in the way that we act and the decisions that we make. Nevertheless, because these types of compelling forces are not salient to us on a day-to-day basis, we do not generally feel that we are constrained by them; it is only when pressed to stop and reflect that we discern that our actions are (at least to some extent) products of our biology and upbringing.

Neuroscience will probably play a similar role in our feelings toward free will. Although it is unlikely that we will dramatically change the way we think about our freedom as we shuffle through our daily tasks, when we pause to consider the reality of our condition, we will be forced to admit that we are constrained by the electro- and biochemical mechanisms silently at work within our brains.

As was previously illustrated, fMRI studies have already begun to elucidate the mechanisms by which our brains make decisions, and faster, more accurate technology is sure to arrive in the near future. Other studies have shown even more direct evidence that our feelings of free will are illusory. Libet, Gleason, Wright, and Pearl (1983) published a series of landmark and controversial experiments in which participants indicated when they had come to the conscious decision to execute spontaneous, voluntary movements. This time was compared to the onset of the “readiness potential” associated with the preparation of motor activity, as recorded by electrodes on the scalp. Libet et al. concluded that participants were not conscious of their decisions to make movements until several hundred milliseconds after the first related cortical activity was detected. While the methods of this experiment have been questioned, more recent follow-up studies (Lau, Rogers, & Passingham, 2006; Lau, Rogers, & Passingham, 2007) have shown similar findings, indicating that our brains know that we are going to move before “we” do.

As neuroscience has advanced, our conscious “knowledge” of our intentions has become more questionable, and the causal relationship between the brain and our behavior has become more evident. As the field continues to progress, it is inevitable that the physical, compelling forces involved in our decision-making processes will be more widely understood and, thus, more salient. And just as the presence of a salient compelling force caused greater
feelings of constraint in the gun example, so, too, will the increased salience and knowledge of the biological underpinnings of our minds. It is in this way that neuroscience will affect our notions of free will.

I would like to reiterate, however, that even with this new knowledge, on a regular basis we will continue to feel largely free. We have been groomed by evolution for thousands of years to operate in this way, and so we will continue to do so. Because of this, we will probably still attribute relative freedom to others as well, and make casual judgments of responsibility just as we did before—blaming our friends when they are late for a dinner party and punishing our children for not cleaning their rooms—however, as the salience of determinism limits our conceptions of free will, we will be forced to reassess how we deal with responsibility in more formal contexts. I turn now to examine the most formal of all contexts for responsibility in our society: the penal system.

Section III: Neuroscience and Responsibility

Legal punishment is classically divided into two theories of justification: retributivism and consequentialism. Retributivism is based on the idea of “just deserts”—one should be punished because he deserves it, even if punishing him will not lead to any measurable benefits for society. Consequentialism, on the other hand, is based on a more utilitarian view, whereby people should be punished because it keeps them from doing more harm to the public and deters other potentially dangerous individuals from committing future crimes. If, as I hypothesize, the public becomes more sympathetic to a deterministic worldview and no longer believes that people possess what we have previously, intuitively called “free will,” what will this mean for the retributivist and consequentialist justifications for punishment?

Determinism and the Retributivist Theory of Punishment

If determinism is true (e.g., if the universe has operated according to set physical laws since the dawn of time and has proceeded forward in the only way possible given the constraints of those laws) then it seems that no one could ever deserve to be punished. After all, we do not blame minors or the mentally ill because we deem that they are not fully in control of their actions and should not be held responsible. Under the assumption of a deterministic universe, we all lack control, and if the only justification for punishment is to give the agent “what’s coming to him,” it is inherently unfair to hold anyone responsible for his or her actions, as agents who lack control should not be punished.

While it may initially seem counterintuitive to do away with retributive punishment, even under deterministic conditions, the following thought experiment should help to elucidate the argument: If someone were holding a gun to Steve’s head and ordering Steve to shoot Mary, we would not blame Steve because he did not have a choice in the matter. We would all agree that he was compelled to act by outside forces and understand why he felt as though he was at the constrained end of the free will spectrum. If Steve shot Mary because he
had a large tumor in his frontal lobe that was affecting his ability to inhibit his actions (and we were completely confident that it was the tumor that led to the action), after analysis, a reasonable person would say that he was equally as constrained in this case as he was in the previous scenario. Even though it is not quite as obvious to us (as the compelling force is less salient), we understand that he was unable to stop himself from pulling the trigger because of a biological condition out of his control, and, thus, he is equally as blameless as before. Now, let us take this one step further: What if Steve did not have a brain tumor, but just happened to have been born such that the mechanisms in his frontal lobes were slightly and undetectably abnormal? He shot Mary as a result of his innately poor inhibition abilities. Would he still be in the clear? To be consistent, we must answer yes. He is just as constrained by his biology in this case as he was in the last scenario, but the compelling force is even less salient than before.

We are all constrained by our biology. Every decision we make is a result of the way our brains have evolved, our individual genetic differences, and the way our environments have molded us. Our brains are physical hunks of matter that are subject to the laws of physics. We did not design our brains, and we certainly did not dictate our genetics, environments or the laws of physics. Therefore, our decisions are out of our control, and if retributivism is our only rationale for punishment and moral responsibility, we should never punish or blame anyone for her actions, and our judicial system needs a dramatic makeover.

However, others disagree with this analysis and claim that there is currently nothing neuroscience can throw at the law that would render it as helpless as the previous argument implies. In a meeting with the President’s Bioethics Counsel (2003), legal scholar Stephen Morse laid out his point of view very clearly: All that is required to hold an agent legally responsible is rationality. Neuroscience cannot yet prove that we are not rational actors, and it is very unlikely that it will do so in the future. Therefore, our penal system will remain unaffected. The law does not care if we are “free” in any philosophical, metaphysical sense; as long as the criminal is rational, regardless of why or how he is considered to be rational, he is culpable for his crime. Morse pointed out that science will continue to be useful in helping us figure out whether or not people were rational agents at the time that they committed their crimes (i.e. was the defendant sleep walking or temporarily insane), but until neuroscience shows that we are, in general, incapable of rational thought processes, the law is safe.

Morse’s argument sounds pretty good on the surface; I agree with his analysis that current and future neuroscientific findings cannot and will not undermine the law in its current framework. However, I join Josh Greene and Jonathan Cohen (2004) in arguing that as society adopts a more deterministic worldview and moves toward the conclusion that humans do not have free will in the intuitive sense that was previously assumed, our moral intuitions will adapt to reflect this knowledge and become incompatible with the penal system in its present form. As Greene and Cohen put it, “The legitimacy of the law depends on its adequately reflecting the moral intuitions and commitments of society.” The real trouble for the law is rooted not in the fact that the existing system is unable to handle new neuroscientific developments, but rather, in the more profound problem that the law is no longer consistent with our changing view of free will and therefore, moral responsibility.
In order to remain in line with our moral intuitions, it seems that our justice system must give up on the retributive justification for punishment. However, as long as the consequentialist argument for punishment can hold up to determinism, there may still be a place for the penal system (albeit a modified version) that is consistent with our changing moral understandings. The reader will remember that consequentialist accounts of punishment are not based on backward-looking ideas of just deserts, but on forward-looking ideas of prevention: It is justifiable to punish those who infringe on the rights of other members of society because it will detain current criminals (and thus keep them from doing more harm) and deter future criminals. This explanation of punishment is consistent with determinism because it does not necessitate that the criminal be held morally accountable. He is not punished because he was in control of his decisions and made a poor choice, but because he is a danger to the public. Taking away his rights will ensure that he will not cause any further harm, and his incarceration will serve as a disincentive to others who, without the threat of punishment, may have acted similarly in the future.

But for every point, there is a counterpoint: Goodenough (2004) argued that consequentialist punishment, just like retributive punishment, relies on an assumption of free will and is, therefore, null and void in a deterministic universe. He claims that when we base our justification of punishment on the value of deterrence, we are making an implicit commitment to the idea that the criminal “had the capacity to fully integrate the threat of punishment into [his/her] decision-making calculus, and to act accordingly, i.e. as if he/she had a kind of free will” (pp. 1807).

The problem with Goodenough’s (2004) argument is that one’s ability to incorporate the costs of punishment does not depend on his being free. Our brain includes new factors into its decision-making every day—I feel hungry; considering this new piece of information, my brain weighs the options and decides that the best course of action is to eat in the near future. The threat of punishment can be treated like any other parameter we consider as we go through our days—Steve was jailed for shooting Mary; considering this new piece of information, my brain weighs the options and decides that the best course of action is to not shoot people. The consequentialist argument does not rely on an assumption of free will, but merely an assumption that we are capable of incorporating new information into our decision-making processes, and this just happens to be the brain’s specialty. Therefore, despite Goodenough’s objection, the consequentialist justification for punishment stands up to the exacting test of determinism. With this established, it seems that our penal system should not be entirely tossed out, but refurbished under the assumption that the goal of punishment is entirely consequentialist, rather than retributivist. (See Greene and Cohen (2004) for a more fully articulated version of this argument.)

Summary and Conclusion

The present paper explored the extent to which neuroscientific findings can inform the free will debate. I argued that neuroscience’s most direct contribution to the argument will be
convincing support for determinism that resonates with the public in a way that no scientific evidence ever has before. Additionally, while this may alter our views of free will theoretically and affect the way we think about moral responsibility and our legal system, we will most likely feel as free on a day-to-day basis as ever before. Although it will take time and work for our justice system to reflect our new understanding of responsibility, it is possible to retain a formal system of punishment in a deterministic world.

My interpretation of the free will vs. determinism debate may seem, to some, unfulfilling, incomplete, or just plain wrong. But regardless of one’s opinions on the topic, it is important that society keep one eye on new research and one eye on its implications. While the answer to the free-will debate may still elude us, we must continue to discuss this age-old question any time new evidence emerges, as our concepts of moral responsibility rest on the answer’s implications. It is important that our justice system continues to reflect society’s moral intuitions, wherever they may lead us; as our self-knowledge changes, so must the law.

References


The Gestural Basis of Spoken Language

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The Gestural Basis of Spoken Language

The spoken language is perhaps one of the most important human capabilities. It is essential for the complex interactions and societies in which humans live. Frantz Fanon, the famous essayist and psychoanalyst, once said, “I ascribe a basic importance to the phenomenon of language. To speak means to be in a position to use a certain syntax, to grasp the morphology of this or that language, but it means above all to assume a culture, to support the weight of a civilization” (Fanon, 1967, p. 17). The human species is unmatched in the animal kingdom relative to the complexity of social and cultural interactions. It is what sets humans apart from the rest of the natural world. Although language is a relatively recent development in the evolution of humans, it has highly specific regions in the brain for its processing. These regions may have evolved from existing areas in the brain via natural selection; specifically regions which controlled motor movements of the arms and hands. Evidence from research done in the areas of comparative and developmental studies as well as fMRI experiments seem to reveal that vocal communication is evolutionarily as well as developmentally dependant on basic gestural communication.

The importance of gestural communication in the human species is often looked over. However, any speech or talk is always filled with gestures that go along with what is being said. Many experts in the field also agree that hand gestures allow for ideas to be conveyed in a more efficient manner than just vocally. On the speaker’s end, gestures may allow for better recollection or organization of thoughts and on the listener’s end, gestures may allow for a better comprehension of speech because of the ability to visualize as well as hear. Hauptmann (1989) conducted experiments in which he asked individuals to tell how to manipulate graphic images on a computer with either language or gestures or both. The study revealed that the individuals were more efficient and comfortable at expressing their ideas via both vocal and gestural communication than either one alone. Thus gestural communication is inherently tied to language as it not only enhances communication but also makes it more efficient.

Studies conducted with gorillas and bonobos also affirm that there is an inherent connection between gestural communication and spoken language. In Pollick and de Waal’s (2007) studies, the researchers noticed that certain hominids show use of gestural communication with the use of hands, feet, or limbs whereas other primates do not. This
implies that gestural communication is a relatively recent ability in the evolutionarily timeline. This characteristic difference is important for the further development of language because it represents a “shift toward a more flexible and intentional communicative strategy in our prehominid ancestors...[such as] a single gesture may communicate entirely different needs or intentions depending on the social context in which it is used” (Pollick et al. 2007). The experimenters wanted to test for the flexibility of the ape languages by comparing bonobos and chimps with gorillas. Since bonobos and chimps are genetically closer to humans than gorillas as well as evolutionarily more modern, the flexibility and the language capabilities may also be more developed. Observations of the ape behavior revealed that apes generally rely on gestures for communication and are more controllable than facial expressions. Thus gestures are capable of holding symbolic meaning and are able to be modified for different contextual situations for different meanings. Observations also revealed that bonobos were able to elicit more effective response from their peers when vocal and gestural communication was used than in chimps or gorillas. Bonobos also seemed to have cultural differences in the meanings of gestures whereas chimps did not. Different populations of chimps had predictable gestures and respective meanings whereas bonobos had varying pairs. Thus Pollick and de Waal hypothesized that, “Repertoire and high responsiveness to combinatorial signaling may have characterized our early ancestors, which in turn may have served as a stepping stone for the evolution of symbolic communication” (Pollick et al. 2007). Mankind’s early ancestors may have had similar traits to that of the bonobo which subsequently became more complex as the ability to vocalize and enunciate arose.

Further evidence of the evolution of language from gestural communication was discovered by Hopkins and Cantero (2003). Their comparative study of chimps and humans revealed that the lateralization of the speech centers may have dated back at least 5 million years. In humans, the Broca’s and Wernicke’s areas are known to be the language centers of the brain and are generally found in the left hemisphere of the brain. Communicative gestures have also been observed to be more dominant with the right hand than left hand and developmental data show that as infants grow, there is an increasingly preferential use of the right hand in communication. Infants who use the right hand during the early stages of life also show increased capabilities in speech. Therefore, the left hemisphere is already hardwired for handedness in communication and the preferential use of the right hand may be present in other primates. Hopkins and Cantero tested for lateralization of communication in chimpanzees by inducing communicative gestures with a banana. The chimps would make gestures for the banana and the handedness of the gesture was recorded. The researchers found that the right hand was overwhelmingly preferred in the communication than the left hand. Thus logically, there must be a deep written lateralization of communication in the chimpanzee brain just as language is lateralized in the human brain. The significance of this is profound in the sense that there was an evolutionarily push for lateralization of communication in the brain well prior to the onset of humans or their closest but now extinct ancestors. Moreover, since gestural communication as well as verbal communication is lateralized, it is reasonable to assume that the cortical areas governing gestural communication were later modified to govern verbal communication.
In order to test for the implications of the Hopkins and Cantero’s research, it is important and necessary to directly look at the cortical areas which control gestures via fMRI research. Hand gestures in humans are controlled by a region of the brain called the primary motor cortex which is at the boundary between the frontal and parietal lobes, also near the Broca’s area. In the macaque, the homologue to Broca’s area is a region of the brain designated as the F5 region. Interestingly, the F5 region control’s the macaques planning and carrying out of motor functions. Since gestural communication is a vital part of vocal communication, there must be some connection between to the two processes. This connection may have been established during the evolution of the brain when the Broca’s area developed from areas of the brain that controlled motor skills. Another interesting attribute to the F5 region is its mirror neurons; special neurons which are activated when an individual carries out motor action as well as when the individual witnesses a similar action. Jeannerod, Arbib, Rizzolatti, and Sakata (1995) were first to notice mirror neurons in Macaques while conducting single cell recordings in the primary motor cortex. The mirror neurons were found to be specific to the inferior frontal cortex of the monkeys’ brains which controls actions of the hands and arms. The macaques were originally being studied to determine how motor neurons coded information for grasping different sized objects in the F5 region. While conducting experiments to determine how motor neurons coded for grasping objects, the team came across an interesting discovery in which they saw certain motor neurons fired when the monkeys watched someone else grasp an object as well as when the monkey itself grasped an object. The finding was very unusual was because the neurons in the F5 region were not known to code for visual stimuli since they were not in the visual part of the brain. However, the fact that the macaque’s neurons fired when witnessing an action as well as when it was the agent behind the action implies that there is some sort of coding for primitive understanding of actions within the F5 region.

Ferrari, Gallese, Rizzolatti, and Fogassi (2003) explored these mirror neurons further and performed more experiments on macaques; specifically their control of the mouth. The experimenters realized that there were a large number of mirror neurons specialized in mouth actions via single cell recordings. They sought out to test whether or not mirror neurons would activate for an indirect action; in other words, an action without a goal. By recording the neural activity of the mirror neurons in the two Macaque’s brains during ingestive actions (direct actions), like biting an apple, and communicative gestures (indirect actions), like lip smacking, the authors were able to determine whether the specific neurons which pertained to the mouth were sensitive to indirect actions. If so, the F5 region may in fact be the beginnings of the Broca’s area because of its ability to „understand” indirect mouth actions which is an essential aspect of spoken language. Ferrari et al. (2003) found that the mirror neurons did fire during indirect actions. Macaque mirror neuron activity during communicative gestures may imply that there is a communicative basis to ingestive actions. For example, a monkey may see an intransitive action (one without a discrete object related action) and relate it to a transitive action (one that is goal oriented). Therefore, the possibility that these neurons evolved into language specific neurons is great. Over time, intransitive actions that carried meaning may have evolved into sounds and eventually into the complex language humans have today.
Further, the mirror neurons may allow for the derivation of meaning from simple tasks such as pointing, the inherent property of language. Tasks may have evolved into using facial and vocal expressions. Although the actual motor and auditory mechanisms behind speech have nothing to do with the meaning of speech, fMRI studies have shown that sound production and mouth actions are highly related to the hand motor cortex. Transcranial magnetic stimulation experiments have shown that an excited hand motor cortex actually increased reading and spontaneous speech skills. The increased rate of firing by the neurons in the region seemed to facilitate the language areas of the region in language production and processing. Furthermore, the effect only happened when the left side of the hand motor cortex was activated, the language side of the brain. There have also been experiments in which grasping actions increased syllable pronunciation; with larger objects, syllables were better enunciated. Fogassi and Ferrari’s (2007) focused research further expands on the motor cortex’s ability to control linguistic actions. The researchers assessed the functions of the motor cortex of the macaque as well as the motor capabilities of the Broca’s areas and compared them to find similarities and to determine what functions have developed in the human brain. Comparing studies, they found that Broca’s area controlled tongue and vocal actions and that the F5 region did indeed control facial movements as well as arm motions. Therefore, it is within reason to conclude that the F5 region further specialized from the control of basic arm and facial motions to the control of vocal cords. The authors also noticed that the mirror neuron system in humans is activated when humans listen or read. Thus a link between the seemingly two distinct systems had been established. In the monkey, there are motor mirror neurons which fire based on sounds and in the human, there are motor mirror neurons which help basic language capabilities.

Further evidence for the tight relationship between gestures and verbal language come from the comparative fMRI research of Sari Levanen et al. (2001). In the study, the experimenters compared cortical activations between deaf users of sign language and non-deaf subjects who did not know any sign language. Specifically, they studied the brain response of both groups while watching a video of people signing. The EEG recordings revealed that although the non-signers did not have any understanding of the sign language, they as well as the deaf group had activations in the language areas in the language areas of the brain further underscoring the gestural basis for communication. Even without any knowledge of the sign language system, Broca’s and the surrounding areas were still activated because of an innate reflex to process gestures.

Developmentally, gestural communication is also vital for the comprehension and learning of language. Iverson and Goldin-Meadow (2005) conducted observational studies with infants as they progressed through their communicative stages. The researchers videotaped children between 10-24 months on a monthly basis from when they produced one-word speech to two-word combinations. The focused on the use of gestures to facilitate speech and hypothesized that gestures played a vital role in the development of the children’s lexical and syntactic skills. They discovered that a child’s vocabulary originated as gestures and eventually was converted to a verbal vocabulary. They also noticed that children who used gestures and words first were developmentally faster in producing two-word combinations. The dependant relationship between gestural communication and vocal
communication is further underscored by children's dependence on gestures in their early communicative stages. The findings also imply that children learn to produce and understand language via gestural communication at first much like the evolution of language from gestures to vocalization. The use of gestures may allow the child to associate meanings with words because of the double association of gestures and words with a meaning and in turn make the important task of learning language easier.

Verbal communication is an essential part of the human species and is one of the driving factors behind the species’ success. However, the system through which verbal communication is processed is essentially a slightly modified version of the gestural communication system existent in mankind's ancient ancestors. As seen with comparative studies between different apes and between apes and humans, there is overwhelming evidence that gestural communication has evolved into vocal communication. Experiments with mirror neurons also reveal a progression of a specific cortical structure from the motor control of hands to the control of the vocal structures as well as an inherent ability to comprehend and understand intentions of actions. Support for the gestural basis of verbal communication is also found in the developmental studies of children and adults. Thus it is logical to conclude the spoken language not only evolved from gestural communication but still depends on it for effective communication. These findings have implications that may reach a various amount of fields as well. Linguists will be able to further understand how to communicate more effectively through incorporating more gestures. The study of autism also may be helped by these discoveries in trying to determine what the basis for the disease is. Since gestural communication is so closely tied to vocal communication, it may be interesting to see how gestural communication is affected in those with autism. These are just a few applications and with a greater understanding of relationship between speech and gestures via evolutionary and developmental studies, the possibilities are endless.

References


What is it like to be a Dualist?  
On the real challenge of Nagel’s 1974 paper

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1. Introduction

In his 1995 book, *The Engine of Reason, the Seat of the Soul*, contemporary philosopher Paul Churchland introduces his theory of recurrent neural networks. He argues that such networks provide a purely physical account of various mental phenomena. Being fully aware of the philosophical complexity of addressing the incessant and difficult “problem of consciousness,” Churchland seeks to defend the physicalist tradition from the famous anti-reductionist arguments offered by Thomas Nagel. In his classic 1974 paper, “What is it like to be a bat?” Nagel attacked physical-reductionism for its inherent inability to account for the subjective characteristic of consciousness.

In defense of his purely physical account of the brain and mind, Churchland attempts to account for the problematic subjective characteristic of consciousness. He seeks to reduce the subjectivity of experience to two purely physical modes of perception: sensory detection through *autoconnected* and *heteroconnected* neural pathways. I will address his account of unique neural pathways in this paper; however, it’s important that I first introduce what follows next in Churchland’s argument.

Although it would seem his reduction of the subjectivity of experience to purely physical neural pathways ought to properly deflect Nagel’s attack, Churchland’s vigorous defense of physicalism continues. He goes further to make the claim that Nagel’s conclusions require the existence of nonphysical objects: “…at some point . . . physical objects of knowledge are suddenly replaced by nonphysical ones . . . that is precisely what Nagel’s conclusion requires” (1995, 199). Thus Churchland insults that Nagel’s 1974 paper argues for dualism.

Churchland’s accusation of dualism, however, is mistaken. Nagel’s 1974 attack on physical reductionism does not provide an argument for dualism - a point that many readers seem to miss. In contrast, the often over-looked point of Nagel’s argument against physical reductions focuses elsewhere: namely, to provoke the pursuit of a more objective understanding of the mental. More specifically, Nagel urged the development of a new objective phenomenology which might hope to capture the subjectivity of conscious experience. Thus, the often-missed point of Nagel’s 1974 paper is develop a new method for filling-in where physical reductions run thin – *not* to argue for dualism.
If contemporary philosophers (such as Paul Churchland) falsely interpret Nagel’s paper as an argument for dualism, this common misconception and the real point of Nagel’s 1974 paper ought to be revealed. Thus, the main goal of this paper is to vindicate Nagel’s 1974 from Churchland’s accusation of dualism. However, questions still loom regarding what it is, precisely, that Nagel means, and hopes to do, with the development of “a new method and phenomenology.” Therefore, in addition to a proper exposition and analysis of Nagel’s anti-reductionist argument and Churchland’s physicalist defense to it, my secondary goal in this paper is to investigate Nagel’s idea of a new method and phenomenology and how it may be satisfied.

2. Background: Physical reductionism, dualism, and the problem of consciousness

For readers unfamiliar with the arguments at hand, I begin with a brief introduction to the fundamental ideas, concepts, and theories surrounding the disagreement between Churchland and Nagel. In the complex sphere of ‘philosophy of mind,’ two relevant explanatory traditions can be distinguished. The most common approach to questions regarding the philosophy of mind is to make an ontological distinction between what constitutes the brain and what constitutes the mind. This classical approach is founded in the theory of dualism, which essentially states that - in addition to the purely physical constituents of the brain - there exists something nonphysical. Traditionally, common examples of what might constitute the nonphysical entities are the mind, soul, spirit, energy, etc.

With the advent of new technology and increasing scientific understanding of nature, organisms, and the human brain, the dualist tradition is slowly diminishing. In its place, scientists and thinkers suggest that all things, including the mind, are of one single substance, and that substance is purely physical. This ontological approach to what exists is known as physicalism or materialism. What is likely to be the most common physicalist approach to explaining the world, including the mind and various mental phenomena, is known as reductionism. The agenda of the physical reductionist is ‘to reduce’ all things to their most basic physical constituents - which leaves no room for nonphysical ones. And it is precisely this, a physical reduction of the mind and various mental phenomena, which Paul Churchland hopes to achieve with his introduction of recurrent neural networks.

In The Engine of Reason, Churchland (1995) applies his novel theory of recurrent neural networks to the defense of physicalism. In particular, he describes how complex recurrent neural networks can account for many complex mental phenomena and functions such as taste, color, smell, and face coding for sensory representation, and more importantly for consciousness. As it is a result of technological and scientific advancement in the last 30 years, much of what Churchland develops is uncharted territory, and requires little philosophical persuasion. However, fully aware of its sheer complexity and unknown nature, Churchland approaches the particularly difficult problem of consciousness with a more philosophically rigorous style.
Even with groundbreaking technological advancements that give us insight into the brain, such as functional magnetic resonance imaging (fMRI), very little can yet be said about consciousness. Traditionally, the most difficult aspect of consciousness is its subjective character. There is something very unique about the subjective experience that seems to transcend purely physical explanations. One may endeavor to understand how we see by reading a chapter on the visual sensory system from a biology textbook. Understanding that we perceive our direct environment because our retinas detect light waves bouncing of objects in our foreground, and that the stimulation of photosensitive neurons in our retinas spark chains of synapses across neural pathways to our visual cortex, is one thing. However, such a chapter on the visual system does not explain what it is like to perceive visually.

It is on account of the subjectivity of visual perception that objective descriptions run thin. Not surprisingly, objective descriptions for any of the human senses are difficult. Describing, in purely physical terms, what it’s like to smell and taste a freshly-baked blueberry pie would be like painting the rainbow with only two colors: an endeavor which would never do true justice to what a rainbow really looks like.

But the difficulties don’t end here. If we find difficulties in describing the subjective experience of the sensory perceptions that most of us are capable of having (such as visual perception), then describing those of sensory experiences are incapable of having (such as echolocation) ought to prove impossible. And this is precisely the point Nagel hoped to make by invoking the question: What is it like to be a bat? Although both echolocation and visual perception are methods in which organisms can detect physical objects in their immediate environment, the method and neural-wiring are completely analogous. We ‘see’ things by detecting light waves bouncing of objects in our foreground. Bats however, ‘see’ things by detecting sound waves bouncing off objects in their foreground.

Thus, Nagel’s clever question brings home the point that there are some features of conscious experiences that seem utterly inexplicable in purely physical terms (albeit, any terms). Churchland exemplifies this point while introducing Nagel’s argument: “. . . no matter how much one might know about the neuroanatomy of a bat’s brain and the neurophysicaology of its sensory activity, one would still not know what it is like to have the bat’s sensory experiences” (195). In other words, no matter how much testing, poking, and prodding neuroscientists might do on a bat brain, they will never be able to describe, what it is like to be a bat. Nagel’s question is meant to show that physical reductions of subjective experiences are exhausted by purely physical descriptions.
3. Heteroconnected and autoconnected neural pathways

Churchland’s defense employs the concept of perception by means of heteroconnected and autoconnected neural pathways. Both forms of perception, one of which accounts for the subjective, occur in purely physical systems. Churchland explains that, as the brain develops, unique neural pathways are created as a causal response to various sensory inputs. Because every brain receives a unique set of sensory input, the causal neural pathways developed, at the level of synaptic connections and strengths, are completely unique. Churchland makes this point by explaining that “. . . each one of us, the bat included, enjoys a unique set of intimate causal connections to the sensory activity of one’s own brain and nervous system” (Churchland 196). Therefore, we all have the ability to perceive our environment and bodies through neural pathways that are completely unique to us.

And in addition to having one-of-a-kind neural pathways, we also have means of perceiving things in our bodies through which no other brains have the ability to perceive. We have a direct neural connection to specific nerves in our bodies that no one else does. In explanation of this point, Churchland invokes an example that describes the experience of perceiving yourself blush. Imagine, for example, you’re blushing because someone has complemented your pretty eyes. Both your admirer and you can perceive, by means of each of your own sensory systems, that you are blushing. Your admirer perceives it with her visual system; she can see your cheeks are red. You, however, perceive it by means of your somatosensory system; you can feel the embarrassing warm tingle reach across your face.

The sensation and perception of blushing on your face is purely physical: the microscopic capillaries in the epithelial tissue of your face are swelling with fresh oxygenated blood - which causes the tinge of red on your cheeks. The only difference in perception of the same objective phenomena (the occurrence of blushing) between you and your admirer is the means (neural pathway) by which you perceive the phenomena. You are sensing it through “autoconnected” means (neural pathways which are connected to perceive changes in your own body), while your admirer perceives it through “heteroconnected” means (neural pathways which are connected to perceive changes that are not occurring in your body). With this example, Churchland emphasizes that, although both perspectives may be different, the object of perception is the same - the physical occurrence swelling capillaries in your epithelial tissue: “the object of knowledge is exactly the same from both perspectives, the subjective and the objective, and it is something paradigmatically physical . . .” (197).

4. Why Nagel’s 1974 paper is not an argument for dualism

Thus, it seems, Churchland has provided an account for how the unique subjective experience can be reduced to purely physical constituents: namely, perception of a phenomena through autoconnected neural pathways instead of heteroconnected neural pathways. However, as mentioned in the introduction, Churchland’s physicalist defense
continues. He argues that, just because each one of us is able to perceive phenomena by means completely unique to us, and through which no others have access (autoconnected neural pathways), it does not follow that what is being perceived is nonphysical: “the existence of a proprietary, first-person epistemological access to some phenomenon does not mean that the accessed phenomenon is nonphysical in nature. It means only that someone possesses an information-carrying causal connection to that phenomenon, a connection that others lack” (1995, 198).

Churchland emphasizes that there is no need to posit nonphysical objects to aid in explanatory accounts of the subjective characteristic of consciousness: “There is no reason to expect, however, that this spectrum from knowledge to relative ignorance should reflect a hidden discontinuity at some point where physical objects of knowledge are suddenly replaced by nonphysical ones” (1995, 199). Churchland explains that, just because we run into difficulties describing the subjective phenomena, it does not follow that there must exist a mind or soul, or something nonphysical. But he insists, “this is precisely what Nagel’s conclusion requires” (1995, 199).

However, there is no mention of nonphysical objects or dualism in Nagel 1974. More importantly, Nagel doesn’t attempt to ‘fill explanatory gaps’ with nonphysical objects, nor does his conclusion require him to do so. Reasons for this reading are numerous. First, although Nagel argues for the existence of facts “... beyond the reach of human concepts,” nowhere does he make mention of nonphysical objects (1974, 4). Rather, he argues that it is perfectly rational to believe in the existence of ideas and facts that are beyond human comprehension and understanding: “Certainly it is possible for a human being to believe that there are facts which humans never will possess the requisite concepts to represent or comprehend” (1974, 4). But this doesn’t require that those facts include nonphysical substances or properties.

This fact ought not be difficult to concede. Consider the intellectual capabilities of a less-developed cognitive creature, such as a chimpanzee. It shouldn’t surprise anyone that such an animal lacks the capacity to comprehend organic chemistry. Actually, it shouldn’t surprise anyone that organic chemistry is something of which most humans lack sufficient understanding. Therefore, should it be difficult to accept that humans, also, have intellectual limitations? The possibility of the existence of things beyond the far reaches of our comprehensibility doesn’t seem completely unlikely. However, the truly pertinent point to draw is: even if we assume there exists things beyond our comprehensive capabilities, there is no reason to assume that the incomprehensible things are nonphysical by nature. Organic chemical substances and properties are not, obviously.

There are additional good reasons to believe that Nagel’s 1974 paper doesn’t intend to provide an argument for dualism. It does not follow that, if one denies the validity of one argument, then one must also accept the truth of the conclusion of its opposition. In Churchland and Nagel’s case, physical-reductionism and dualism seem to be the opposing theories. Nagel makes it very clear that he denies the explanatory capabilities of physical reduction, and thus its validity: “... we have at present no conception of what an explanation of the physical nature of a mental phenomenon would be” (Nagel 1). But does such a denial
imply an argument for dualism? Nagel makes no mention, nor argument, for dualism. Philosophers ought to approach all theories with skepticism, even the ones they support. This way, theories are constantly developed and their weaknesses are exposed for revision.

As an illustration of the above point, consider the agnostic who argues that atheism cannot be true. She might say: “we cannot accept the conclusion of a valid argument as true unless we also know that its premises are true. However, the premise of atheism is that one knows God doesn’t exist. Proving the inexistence of God may be impossible, therefore we can’t accept the atheist’s conclusion as true.” This is clearly an argument against atheism, but is it an argument for the opposing view, theism? The answer is no. The agnostic denies the truth of the conclusion of both atheism and theism. Is it not the case that one can deny physical reductionism and its opposition, dualism?

Finally, although Nagel’s 1974 ‘attack on physicalism’ is one key point of the paper, its larger spur is to provoke the development of ‘a new method and phenomenology.’ Nagel says explicitly that it would be a mistake to claim that physicalism is false (Nagel 7). What he really wanted to propose was that philosophers attempt to develop a new method and phenomenology for describing the difficult subjective character of subjective experiences. The goal would be “to describe, at least in part, the subjective character of experiences in a form comprehensible to beings incapable of having those experiences” (Nagel 9). This method and phenomenology would, for example, attempt to explain visual experiences in a manner that a blind person could comprehend.

What exactly does Nagel mean by “a new method and phenomenology?” As I hope to have shown, Churchland defended physicalism from an attack that Nagel never made; namely, that the inexplicable subjective character of conscious experiences provides an argument for dualism. However, if the real goal of Nagel’s 1974 paper was to provoke the development of ‘a new method and phenomenology for describing the subjective character of experiences in a form comprehensible to beings incapable of having those experiences,’ then a new question arises. Does Churchland’s appeal to recurrent neural networks take a step toward what Nagel 1974 was really after?

5. A possible new method and phenomenology: vector coding and three-dimensional “sensory spaces”

Surprisingly enough, although Churchland doesn’t explicitly attempt to provide a new method and phenomenology, he does provide a unique account for visualizing sensory representations. Perhaps his sensory state spaces are a step toward providing what Nagel is looking for. Churchland explains that the human capacity for verbal description using language is dwarfed by the incredible capacity of sensory functions because each relies on completely different coding strategies. In language, we (humans) use a finite domain of names to represent things, which often fall short of difficult descriptive tasks (like describing subjective experiences). In contrast, the human nervous system relies on an extremely
complex system of analysis and representation that Churchland explains in terms of vector coding.

Although Churchland’s account of vector coding for various sensory experiences is far more complicated than I can explain here, the following is a brief account of its fundamentals. Churchland explains how one can evaluate the various synaptic weights of a network encoding a specific sensory experience – the taste sensation of something bitter for example – in a visually representational manner that takes the form of a three-dimensional diagram representing a specific ‘sensory space.’

Figure 1 represents three of the four distinct types of taste receptors on the human tongue; sweet, sour, and salty (the fourth, bitter, is left out of the diagram for illustrative purposes). When a substance is introduced to the taste receptors on the tongue, it consists of a specific combination of various chemicals that stimulate each distinct type of taste type differently. So an apple, for example, will heavily excite the sweet taste receptors, while the sour, bitter, and salty may receive a different combination of slight stimulation. (Churchland, for the sake of simplicity and illustration, assigns each taste receptor a level of stimulation on a scale from one to ten. Receptors at a stimulus level of one are activated much less by the substance than receptors at a level of nine or ten.)

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Taste space: the position of some familiar tastes. (Adapted from Jean Bartoshuk.)
Churchland explains that each and every flavor, from sushi to bacon, has a distinct 4-element activation code or pattern – the combination of activities generated in each of the receptor types. The unique approach Churchland takes is to draw a three-dimensional diagram where each axis is represented by the activation level for each type of receptor. This creates what a sensory space, where specific flavors can be visually represented on the diagram. What’s more interesting is that when this method is used, a natural organization of subjective taste experiences reveals itself. We find that particular corners and spaces of the sensory space cube constitute a specific type of receptor. This allows relative comparisons of various flavors pinpointed in the taste space.

All this become relevant toward considering how sensory space representations may be used to address Nagel’s (1974) real challenge. Churchland covers four sensory modalities in his 1995 book: taste, color, smell, and facial recognition. It isn’t difficult to see how these sensory spaces may be used to aid people incapable of having certain experiences. Although the color space may not help a colorblind person see color, it might certainly help them obtain an understanding of the relative relations of all the colors in the human visual spectrum. This is because each visual color experience corresponds to a specific activation pattern, in the retinal cone cells which can be mapped onto Churchland’s color space. This way, the actual scientific configuration of real might be represented in a manner comprehensible to a colorblind person.

6. Final thoughts and conclusion

Such examples are few and still very conjectural. Philosophical applications of these ideas of sensory state spaces are still undeveloped, and a complete physical account of sensory inputs for each type of sensory experience will have to be established first. However, it’s important to note that Churchland’s theory does provide, although incomplete, a start toward describing experiences in a manner comprehensible to beings incapable of such experiences. However, the question still remains: how realistic is Nagel’s 1974 request? Is a full and true new method and phenomenology possible? Is it necessary? What does Nagel hope to achieve with such an endeavor? Improving our descriptive accounts of subjective experiences seems a reasonable goal. However, filling in the content of his request in light of scientific understanding seems unclear.

One possible approach appeals to advances in technology. The fact of the matter is that science has been using technology to provide experiences humans have never been, and never will be, capable of having using their own natural sensory systems. A few moments on an internet browser generating images from specific technologies across the your computer screen: ultrasound, chemical-imaging, electron microscopy, fluoroscopy, magnetic resonance imaging (MRI), projection radiography, tomography, positron emission tomography (PET), photo acoustic imaging, etc. (the list goes on). Each of these technologies create visual representations of things we humans are incapable of experiencing unaided.
On reflection, however, this answer seems all-to-convenient. The real challenge lies in Nagel’s original example: cross-sensory matching of analogous sensory systems. What’s different about the above examples and describing what it’s like to be a bat is that these machines conveniently translate things into a sensory function we are capable of in the first place. With echolocation however, we must attempt to translate experiences across sensory functions completely. But do we need to know what it’s like to be a bat? Isn’t, for example, ultrasound imaging close enough for Nagel’s real purpose?

If we really wanted to challenge our scientific and philosophical capabilities, we might try translating specific sensory stimulus into sensory receptors not designed to receive such stimulus. For example, instead of translating all of these naturally invisible occurrences into visible images (like thermal radiation being translated into the human visual spectrum for example), one might endeavor to translate experiences of one existing sensory system, such as the gustatory system (taste), into a completely different system, such as the olfactory system (smell). Although completing such complex tasks may point us in the direct direction for answering Nagel’s challenge, however, the question still looms what he’s really asking for.

It would be necessary to complete a very scientific account of precisely what the human sensory systems are capable of detecting in the external environment. Briefly, the visual system can account for wavelength, frequency, and intensity of a segment of the electromagnetic radiation. The auditory system (hearing) detects changes of atmospheric pressure by registering wavelength, frequency and intensity of sound waves. The olfactory and gustatory systems give humans the ability to detect specific chemical signatures in the surrounding environment. Given the incredible speed in which we are advancing technologically, cross-translating a few of the above sensory inputs may not be so far out of sight.

And for Churchland’s sensory space, such goals might still not be impossible. Consider a to-scale comparison of analogous sensory spaces. Where might the vector code of the color red fit on the taste space, or the smell space? Cross-translations and comparisons of Churchland’s sensory spaces might be able to work as a bridge to a closer understanding of the relations of sensory experiences for people incapable of specific experience. Unfortunately for the blind however, Churchland’s sensory spaces won’t be so useful until someone devises a new method and phenomenology of creating sensory spaces representing at visual parameters that don’t rely on a functioning visual system.
References


Overcoming Cartesian Intuitions: A Defense of Type-Physicalism

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1. Introduction

Type-physicalism is the view that sensory states and properties are identical with their nomologically correlated brain states and properties. The main challenge to this view is how to overcome conceivability arguments such as the conceivability of disembodiment or of zombiehood. In this paper, I explain how I think the type-physicalist should respond to such arguments. More specifically, I want to argue that even if the separability of, for instance, pain and c-fiber stimulation, is ideally conceivable, this does not show that it is possible. This is because pain and c-fiber stimulation might be one and the same property in reality and yet their separability would still be conceivable, given the deep psychological differences between the concepts we use to pick out sensory properties and the concepts we use to pick out physical properties.

A rough sketch of my argument is as follows. First, I explain how the conceivability of p might fail to be an accurate guide to the possibility of p. Then, having shown this, I argue that there are good independent reasons to think that conceivability is in fact an unreliable guide to possibility in the case of consciousness. Finally, I respond to some tough objections to this line of thinking. It is important to realize that my argument does not seek to show that the conceivability of sensory properties without their correlated brain properties necessarily represents an impossible state of affairs. This would take a much stronger argument than that of which I claim to be in possession. Rather, I merely argue that it is plausible to think that conceivability systemically misleads us in the case of consciousness. Put simply, I agree that it is possible for modal intuitions over consciousness be true. I just think that there are

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1 Type-physicalism should be distinguished from token-physicalism. The latter view holds merely that every state that instantiates a sensory property also instantiates a brain property. As such, it is compatible with the idea that while all sensory states are also brain states, the property that makes that state a sensory state is distinct from the property that makes that state a brain state. Type-physicalism is a much stronger thesis; it claims that sensory properties just are brain properties. Type-physicalism thus entails token-physicalism, but not vice versa.

2 It is now known that much more goes on in the brain when we experience pain than c-fiber stimulation. The neuroscientific details are not really important, though. If the reader wishes, she can substitute ‘pain’s nomologically correlated brain state’ for every instance of ‘c-fiber stimulation’ in what follows.

3 I assume that the separability of sensory properties and brain properties is ideally conceivable. One could of course respond to conceivability arguments by denying this. I do not consider such a strategy in this paper.
very strong reasons in favor of rejecting them.

2. Conceivability and Possibility

Conceivability arguments all have the form ‘it is conceivable that \( p \), therefore, it is possible that \( p \)’. For example, the antiphysicalist argues that the separability of pain and c-fiber stimulation is conceivable; therefore, it is possible for these properties to come apart. Or sometimes one will see an analogous argument made at the level of all sensory properties and brain properties: it is conceivable for there to be a disembodied being who has sensory experiences; therefore, such a being is possible. Whichever argument is made, the important point is that such arguments presuppose that conceivability is an accurate guide to possibility. We shall call this idea the conceivability-possibility principle. The question is: why think that this principle is true?

Prima facie, it seems that there are clear counterexamples to the conceivability-possibility principle. For example, I can conceive of jumping 100 ft. high. Or alternatively, I can conceive of eating an entire elephant in one sitting. But neither of these states of affairs is possible. Perhaps there is a similar kind of illusion in the case of consciousness. Doesn’t this show that conceivability arguments are no good? The answer is “no”. The conceivability-possibility principle can be saved by distinguishing between nomological possibility and metaphysical possibility. Roughly, the difference is this: a state of affairs \( p \) is nomologically possible when it could happen given the way the world in fact is. The idea here is that we hold fixed the actual laws of nature as well as certain other facts about the actual world.\(^4\) In contrast, a state of affairs \( p \) is metaphysically possible when it could happen given a very different world. This sense of possibility thus includes states of affairs that could only happen if the laws of nature were different and if certain other facts about objects and properties in our world did not hold.

The upshot of this distinction is that these apparent counterexamples to the conceivability-possibility principle can be removed. For example, while it is nomologically impossible to jump 100 ft. high, it is metaphysically possible. In other words, in a world where the law of gravity was sufficiently weaker, this state of affairs would be possible. Similarly, while it is nomologically impossible to eat an entire elephant in one sitting, it is metaphysically possible; in a world where human physiology was sufficiently different, this state of affairs would be possible. Therefore, by qualifying the conceivability-possibility principle, the above conceivability arguments can be put back on firm ground. They argue that, for instance, since the separability of pain and c-fiber stimulation is conceivable, it is metaphysically possible.

One might object that the notion of metaphysical possibility is too weak to refute type-

\(^4\) Of course, we do not hold all the facts of the actual world fixed. For then our possible world would be identical with the actual world, and nothing would be different. The kind of facts we hold fixed are of a more general type, pertaining to the natural world. The technical details of this concept are not crucial to my presentation. An intuitive grasp of it suffices.
physicalism. This is because *everything* seems possible in the metaphysical sense of the term. As such, even if the separability of sensory properties and brain properties is metaphysically possible, it is inconsequential. However, this line of thinking is flawed for the following reason: even in a world very different from ours, there could not be married bachelors. This is *not* the claim that married men could not be called ‘bachelors’. If speakers in such a world used the term ‘bachelor’ to denote married men over the age of fifty, say, then the statement ‘there are married bachelors’ would be true in that world (assuming, of course, that one married man over the age of fifty existed.) But *we* would not treat this as a world containing married bachelors. Alternatively, even in a world very different from ours, the number three could not come before the number two. This is *not* the claim that the number that comes before two could not be called ‘three’. If speakers in such a world used the term ‘three’ to denote the number one, then the statement ‘three comes before two’ would be true in that world. But *we* would not treat this as a world in which the number three comes before the number two. This shows that some states of affairs are impossible even in the metaphysical sense of the term. Therefore, one cannot simply dismiss the notion of metaphysical possibility without further argument.

Finally, fed up with the very notion of possible “worlds”, one might object as follows: even if the separability of sensory properties and brain properties is metaphysically possible, why should this matter? Type-physicalism holds that these properties are identical in the *actual* world. Therefore, the fact that these properties can come apart in a fundamentally different world does not show that type-physicalism is false. The problem with this objection is that it fails to understand the relation of identity. As Kripke showed in his “Naming and Necessity”\(^5\), if \(A = B\), then \(A = B\), not just in every nomologically possible world, but in every metaphysically possible world as well. For if \(A\) and \(B\) are really one and the same, how could changing the laws of nature or altering any other facts possibly cause them to be distinct? The notion that, under any circumstances, one and the same thing could have been two distinct things is self-evidently absurd. Those who remain unconvinced have probably mistaken the relation of spatio-temporal continuity with that of identity.\(^6\)

We are now in a position to clearly state the challenge that conceivability arguments pose for type-physicalism. (1) Type-physicalism holds that, e.g., pain = c-fiber stimulation, and so (2) pain = c-fiber stimulation in every metaphysically possible world. But (3) the separability of pain and c-fiber stimulation is conceivable, thus (4) there is a metaphysically possible world in which pain exists independent of c-fiber stimulation. But by (2) and (4), we get a contradiction. Therefore, pain is not identical to c-fiber stimulation. So, type-physicalism is false.

In the next section, I shall argue that the inference from (3) to (4) is unsupported. There

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\(^5\) See Kripke’s “Naming and Necessity” (1972).

\(^6\) What I mean is this. A skeptic has probably confused the property of being continuous in space and time with the relation of being identical. A statue and the portion of clay it is made of are continuous in space and time; in this sense, we could say they are “one”. However, they are not identical. For the statue cannot survive being rolled up into a ball, while the portion of clay can. (See Gibbard’s “Contingent Identity” for an opposite view.)
is another explanation as to why the separability of sensory properties and brain properties is conceivable. Moreover, I think there are strong independent reasons suggesting that this alternative explanation is the right story to tell. I turn now to the issue of how it is \emph{a priori} possible for the conceivability-possibility principle to be false. The crucial ingredient in my argument is Loar’s distinction between concepts and properties, as put forth in his “Phenomenal States” (1997). In a nutshell, my strategy will be to argue that the separability of sensory properties and brain properties would be conceivable even if they were one and the same in reality. This follows from the deep psychological differences between the concepts we use to pick out sensory properties and the concepts we use to pick out brain properties. Accordingly, since there is every independent reason to think that sensory properties and brain properties are in fact the same, I conclude that we should be very skeptical of conceivability arguments seeking to show that they are distinct.

3. How the Conceivability-Possibility Principle Might be False

My argument presupposes that what is conceivable and what is metaphysically possible are \emph{not} the same thing. As such, it would be possible for someone to object to my argument by denying that we even possess the concepts necessary to draw such a distinction. However, I think such a view is highly implausible. The notion of some state of affairs being conceivable while at the same time being metaphysically impossible makes perfect sense. The idea is here is that for some state of affairs \( p \), there exists a metaphysical necessity preventing \( p \) from obtaining even in a world radically different from ours, despite the fact that \( p \) is conceivable. Put otherwise, one can say that there might be a state of affairs \( p \) such that when Mother Nature created the universe, she could not make \( p \) the case. But given certain features of our cognitive system, \( p \) is bound to be conceivable, and consequently, the reason that Mother Nature could not make \( p \) the case is something that will forever remain beyond human comprehension. If I am correct, then the distinction between conceivability and metaphysical possibility makes \emph{prima facie} sense. But we have not yet explained how a state of affairs could be conceivable while at the same time being metaphysically impossible. In order to explain this, we must distinguish between concepts and properties.

Loar explains that we do not grasp properties directly, but rather by virtue of \emph{concepts}. Put roughly, a concept \( C \) of a property \( P \) is a way we have of thinking about \( P \). For example, my concept of the property water might include that it is my favorite drink. Moreover, the application of a concept to an instance involves the exercise of psychological abilities. For example, certain concepts involve dispositions to behave in such-and-such a way. The important point is that concepts are tied essentially to certain features of our cognitive system. In comparison, a property \( P \) is simply a way some subject might actually be, independent of ours ways of conceiving of that subject. For example, \emph{being a liquid} would still be a property of water under appropriate circumstances, even if no cognitive agents existed to conceptualize water as being that way. Properties are thus a part of the furniture of the objective world; they are not determined by our concepts, but rather by natural features of
the world itself. For our purposes, the upshot of this distinction is that it is a priori possible for one property to be conceptualized into two independent ways such that the resulting concepts can come apart in imagination, despite the fact that they pick out one and the same property in reality. Not surprisingly, I shall argue that this is what happens in the case of consciousness. Below, I explain the details of this account.

The concepts we use to pick out sensory properties differ from the concepts we use to pick out brain properties in at least two significant ways. First, sensory concepts are recognitional. As such, they do not scientifically conceive of their referents in terms of structure and function, but rather as being of such-and-such a general type of inner property; beyond this, no further description of the referent occurs. In comparison, the concepts we use to pick out brain properties are physical-theoretical. This is important because physical concepts conceive of their referents precisely as properties exhibiting a certain structure and function (where these features are given meaning within the relevant scientific framework). Second, the application of these two types of concepts to instances involves very different psychological abilities. For example, applying a sensory concept to an inner property involves the exercise of attention, introspection, and recognition. Furthermore, it often involves the exercise of certain behavioral dispositions, such as to rub a certain area in the case of pain. In comparison, the application of a physical concept to a brain property involves the exercise of perceptual, verbal and theoretical abilities. Accordingly, it is hardly controversial to assume that there are deep psychological differences between the two kinds of concepts, both with respect to how they conceive of their referents and with respect to the different psychological abilities that they involve.

Now we wanted an alternative explanation as to why the separability of sensory properties and brain properties is conceivable, one that does not assume that it is because it is metaphysically possible for these properties to come apart. That’s to say, we wanted an explanation of how the conceivability-possibility principle could be false. It is clear that we now have such an explanation. (i) If, e.g., pain = c-fiber stimulation, then (ii) pain = c-fiber stimulation, not just in every nomologically possible world, but also in every metaphysically possible world. However, (iii) given the deep psychological differences between the concepts we use to pick out our pains and the concepts we use to pick out c-fiber stimulation, (iv) the separability of these properties would be conceivable, i.e., these concepts would come apart in imagination, despite the fact that they pick out one and the same property. For how could we expect them not to come apart? Surely nothing about the concepts themselves could prevent this. Put simply, then, this would be a situation in which a state of affairs p would be conceivable despite being metaphysically impossible. Since sensory properties and brain properties may in fact be identical, it is a priori possible for the conceivability-possibility

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7 The following points draw heavily upon Loar’s discussion of sensory (what he calls ‘phenomenal’) concepts and brain concepts.

8 A concept conceives of a property in terms of structure when it reveals the physical composition and organization of that property. A concept conceives of a property in terms of function when it reveals the causal relations that property bears to other properties, objects, and events.
principle to be false.

This shows how it is possible for conceivability to systematically mislead us into thinking that sensory properties are irreducible. However, we have not yet given any reason to think that what we conceive of in such cases is in fact false. In the next section, I present the reasons for thinking that the conceivability-possibility principle is false. My basic strategy will be as follows. First, if as the antiphysicalist maintains, the conceivability of sensory properties without their correlated brain properties entails such a state of affairs is metaphysically possible, then some form of property dualism is true. (Conceivable states of affairs that prima facie support property dualism I shall call ‘Cartesian intuitions’\(^9\).) Second, I argue that, if property dualism is true, then some highly plausible scientific and commonsense views about the physical world and the place of consciousness in that world are false. Therefore, given that it is a priori possible for the conceivability-possibility principle to be false anyway, I conclude that it is more probable that Cartesian intuitions are false.

4. Positive Reasons In Favor of Rejecting Cartesian Intuitions

If what I have said so far is true, then whether the conceivability-possibility principle is true is an empirical question. I want now to present my reasons in favor of rejecting the principle. As I mentioned above, I shall argue that the principle is likely false for it implies property dualism. The problem with property dualism is that it is inconsistent with some very plausible scientific and commonsense views that should not be given up. Or at least to reject these views merely because the separability of sensory properties and brain properties is conceivable would be a serious mistake, given the foregoing remarks on conceivability.

If Cartesian intuitions are true, then it is metaphysically possible for sensory properties to exist independent of their correlated brain properties. To give a concrete example, such intuitions hold that it is metaphysically possible for pain to exist independent of \(c\)-fiber stimulation. But if that’s true, then pain and \(c\)-fiber stimulation are distinct properties. For, under any circumstances, it is absurd to think that one and the same property might have been two distinct properties. Accordingly, if conceivability is an accurate guide to metaphysical possibility, then some form of property dualism is true (i.e., the view that there are two fundamentally different kinds of properties in the world: sensory properties and physical properties). But if property dualism is true, then some very sound scientific and commonsense views about the physical world and the place of consciousness in that world are false. Therefore, we cannot merely accept Cartesian intuitions at face value while holding that our other views are correct. Below, I flesh out this inconsistency.

First, there is a systematic relation between sensory properties and brain properties. Here is the evidence. (i) For every occurrence of a certain type of sensory property, there is a simultaneous occurrence of certain type of brain property. For example, whenever we are experiencing pain, our \(c\)-fibers are undergoing stimulation, and vice versa. (ii) By

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\(^9\) This is the terminology adopted by Hill and McLaughlin in their (1998).
administering certain drugs that affect brain properties, we simultaneously affect sensory properties. For example, whenever we drink alcohol, the changes in brain properties are accompanied by changes in sensory properties. (iii) Finally, if part of the brain correlated with a certain type of sensory property is damaged, we no longer experience that type of sensory property. For example, if one’s c-fibers are damaged, one no longer experiences pain.

Why is this a problem for property dualism? Property dualism holds that there are in fact two properties here, not one property conceived of in two independent ways. But if that’s the case, we will need new laws of a fundamentally different kind, correlating sensory properties and brain properties. Such laws would falsify our current scientific view of the world. To see this, consider the following.

According to contemporary physics, if there are any physical laws that we have not yet discovered, they are bound to be laws governing the behavior of microscopic entities. That’s to say, they will be laws governing the behavior of protons, neutrons, and electrons, or smaller entities still. The reason to think this is that in principle the behavior of macroscopic entities such as tables and chairs can be predicted and thus explained by the behavior of the microscopic entities that compose them. Therefore, it would come as a great shock to physics were we to discover new physical laws governing the behavior of macroscopic entities. However, if sensory properties and brain properties are distinct, then this picture is radically false. For brain states are also nothing over and above the particles that compose them. There is nothing mysterious about brain properties; they are perfectly well-understood within the confines of contemporary physics. Thus, new laws correlating sensory properties and brain properties would entail that particles that behave in a uniform way throughout the physical universe, suddenly behave very differently when organized into brain properties: they are accompanied by qualitative sensory experiences! Furthermore, think of the sheer number of new laws that this would presumably require. Prima facie, it seems that we would need a new law for every type of sensory property. Surely, at this point it is obvious that something has gone wrong. This would be a ridiculous price to pay merely to accept Cartesian intuitions, given that they are possibly false anyway.

Turn now to the challenge property dualism poses to commonsense. There is perhaps no stronger intuition than the notion that sensory states can cause behavior. The idea is that my experience of pain causes me to behave in certain ways, e.g., to rub the painful area, to utter certain verbal reports, to avoid the painful stimulus, and so on. One might argue that any theory which fails to account for the causal interaction of sensory properties and physical properties should be rejected as absurd. However, if property dualism is true, then this view is false. To see this, consider the following.

First, it seems that the physical world is causally closed. In other words, for any physical event \( e \), it seems that there can only be another physical event \( e^* \) that caused \( e \). Why is this a problem for property dualism? Behavior is physical in nature. For example, consider removing your hand from a hot stove. This involves the firing of certain neuron populations in the brain, the conduction of electrical impulses down the spinal cord, and finally the

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10 Additionally, this idea is crucial to many of our folk-psychological explanations of our own and others’ behavior.
contraction of certain muscle groups in the arm. However, if we search for the cause of this behavior, all we ever find is other physical events in the brain and nervous system; we never find anything non-physical. Therefore, if pain and c-fiber stimulation are not identical, it is c-fiber stimulation, not pain, that is the cause of your moving your hand. (Worse yet: together, these physical events form a causally sufficient condition for your behavior. That's to say, there is no gap in the causal chain where a non-physical thing need exert its influence. We do not need to postulate anything further to fully explain how your behavior occurred.) Second, even putting these worries aside for the moment, it’s not even clear how something non-physical could in principle interact with something physical. This was Princess Elizabeth’s objection to Descartes. These considerations strongly suggest that property dualism entails epiphenomenalism about sensory properties. Accordingly, it would be a mistake not to reject Cartesian intuitions, given that they are possibly false anyway.

If these arguments are right, then there is strong reason to think that the conceivability-possibility principle is false. For it implies property dualism, and the latter is inconsistent with some highly plausible scientific and commonsense views. However, one might object that property dualism need not have such consequences. To this extent, by far the most attractive theory is something along the lines of Maxwell’s nonmaterialist physicalism. Roughly, Maxwell’s idea is that brain concepts such as ‘c-fiber stimulation’ rigidly refer to intrinsic properties of matter. In other words, brain concepts are two-dimensional in the way that other natural kind concepts such as ‘water’ are two-dimensional; the property which fixes the reference of ‘c-fiber stimulation’ is distinct from the property that it picks out, just as the property that fixes the reference of ‘water’ is distinct from the property that it picks out. Maxwell then argues that, e.g., while the structure and function of c-fiber stimulation does not entail pain, it is possible that the intrinsic nature of the physical state that realizes c-fiber stimulation in the actual world entails pain.

In short, by locating sensory properties at the level of matter, it seems that Maxwell's theory would allow that particles behave in a uniform way throughout the universe; we would not need laws of a fundamentally different kind. Moreover, sensory properties would be “built in” to the physical states realizing brain properties; hence, epiphenomenalism can be avoided. If successful, this theory would effectively undercut my argument. There would no longer be any reason to doubt that the conceivability-possibility principle is true. For the conceivability of sensory properties and their correlated brain properties can be explained away as follows: when it seems that we are conceiving of, for instance, pain that is not c-fiber stimulation, what we are really doing is conceiving of pain that lacks the superficial structure and function of c-fiber stimulation. We are not conceiving of pain that lacks the intrinsic properties of the physical state that realizes c-fiber stimulation in the actual world. As such,

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12 More fully: the property that guides us in picking out instances of c-fiber stimulation is ‘having such-and-such a structure and function’. However, this property picks out a further, distinct property; it picks out an intrinsic property of matter. Similarly, the property that guides us in picking out instances of water is ‘being a clear, odorless liquid that fills the oceans and lakes on Earth’. However, this property picks out a further, distinct property; it picks out the property of being H2O.
we are not truly conceiving of pain without c-fiber stimulation. However, there are serious problems with taking this line of response to my argument.

First, Maxwell's theory allows one to hold on to the scientific and commonsense views I mention only by making further counterintuitive assumptions. For example, by locating sensory properties at the level of matter, we are forced to accept that there is something it is like to be a particle. However, we seem very justified, both on scientific and commonsense grounds, in thinking that consciousness in this sense is something that only higher mammals enjoy: we don’t think there is something it is like to be a bacterium, never mind an electron or quark! Second, Maxwell's theory is a substantive metaphysical thesis that suffers from tough objections of its own. One such objection is the so-called combination problem; roughly, how sensory properties located at the level of matter could combine so as to form smooth, continuous sensory states, such as visual sensations. As such, his theory would have to derive large-scale support from other arguments and considerations. As things stand, it does not look like such support is imminent.

To sum up, I have argued that Cartesian intuitions should be rejected because they are inconsistent with highly plausible scientific and commonsense views about the physical world and the place of consciousness in that world. Hence, it is not a good strategy to seek to undercut my argument by making further assumptions that equally conflict with other of our rational commitments (for example, if Maxwell's theory is true, we must give up the idea that there is nothing it is like to be a particle). Moreover, rejecting Cartesian intuitions seems to be the more reasonable option, given that there is no good independent reason to accept Maxwell's theory, aside from the fact that it obeys the conceivability-possibility principle. However, it would be absurd to accept such a bold metaphysical view simply because the separability of sensory properties and brain properties is conceivable, particularly when we have already explained how it is a priori possible for the conceivability-possibility principle to be false.

5. Objections and Replies

**FIRST OBJECTION:** Your argument presupposes that one and the same property might be conceptualized in two independent ways. (Two concepts \( C \) and \( C^* \) are independent when one cannot connect them independent of experience, i.e., a priori.) But that seems possible only if the two concepts involve different reference-fixing properties. For example, it is possible for one and the same physical property to be independently conceptualized as both ‘heat’ and ‘molecular motion’, but this is only because the property that guides us in picking out heat in the actual world, viz., being the cause of such-and-such a sensation, is different from the property that guides us in picking out molecular motion in the actual world, viz.,

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13 In other words, it allows one to explain way separability intuitions about sensory properties and brain properties using Kripke’s model. Kripke first presented this model in his (1972).

14 For a discussion of the combination problem, see Chalmers’s “Consciousness and Its Place in Nature” (2002).
having such-and-such a structure and function. However, this explanation is not open to you, for type-physicalism holds that, e.g., the property that guides us in picking out pain is identical with pain itself, and also that the property that guides us in picking out c-fiber stimulation is identical with c-fiber stimulation itself. Accordingly, if you want to hold that sensory concepts and brain concepts can be independent, then you must also hold that they involve different reference-fixing properties. Since type-physicalism implies that these two conditions cannot hold at the same time, your account is unstable.

**FIRST REPLY:** This objection is flawed for it presupposes that (i) if two concepts have the same property as reference-fixer, then (ii) one would be able to see this *a priori*. However, such an idea is badly flawed. For one thing, it seems to place ridiculously high standards on human cognitive abilities such that no cognitive-psychological factors might prevent one from seeing this *a priori*. Furthermore, I think that there are positive reasons, at least in the case of consciousness, to suppose that psychological factors would prevent one from seeing that sensory concepts and brain concepts coreferred, despite having the same property as reference-fixer. This is because sensory concepts do not scientifically conceive of their referents in terms of structure and function but rather as being of such-and-such a general type of inner property. In comparison, brain concepts are physical-theoretical and thus conceive of their referents precisely as properties having such-and-such a structure and function. Given these differences between sensory concepts and brain concepts, it would be unreasonable to think that one could connect them *a priori*. That would require sensory concepts to analyze their referents either as having structure $S$ and function $F$ or else as having $X$, where $X$ implies having $S$ and $F$. Or alternatively, the ability to connect them *a priori* would require that brain concepts conceive of their referents as being such-and-such a general type of inner property or else conceive of them as being $Y$, where $Y$ implies being such-and-such a general type of inner property. But given the different psychological abilities that underlie the two kinds of concepts (introspection and recognition in the case of sensory concepts, perception and verbal-theoretical analysis in the case of brain concepts), neither is possible. Therefore, it would be tendentious to assume that two concepts could not have the same property as reference-fixer while being independent of each other, for they might be independent merely because of certain psychological factors of our cognitive system. To deny this would be to miss the point of the concepts/properties distinction altogether.

**SECOND OBJECTION:** You intend for your argument to be limited only to Cartesian intuitions. But given that it is the fact that such intuitions involve distinct kinds of concepts, or concepts that play distinct conceptual roles in our cognitive system, a similar argument might be made about a wide-range of our modal intuitions. For example, while it is nomologically impossible to jump 100 ft. high, no one would want to deny that it is metaphysically possible. However, given the distinctness of the concepts ‘human’ and ‘jump’, one could make the argument that such a state of affairs would be conceivable even if it was metaphysically impossible. Analogous remarks apply to any other modal intuition involving distinct kinds of concepts. Therefore, if we reject Cartesian intuitions, we should reject a wide-range of other modal intuitions. The result is a wide-reaching modal skepticism that threatens to undermine our most basic modal notions, such as validity, entailment, and
consistency.\textsuperscript{15} Surely, this is an unacceptable consequence.

\textbf{SECOND REPLY}: I agree that my argument entails that a wide-range of our modal intuitions may in principle be false. For example, given the distinctness of the concepts ‘human’ and ‘jump’, and given the different conceptual roles that these concepts play in our cognitive system, it seems clear to me that jumping 100 ft. high would be a conceivable state of affairs even if it was metaphysically impossible. This much seems to follow from both the idea that conceivability and metaphysical possibility are not the same notion and Loar’s distinction between concepts and properties. However, this is not the reason I actually give for rejecting Cartesian intuitions. It is crucial to see this. Cartesian intuitions are \textit{not} to be rejecting as false merely because the separability of, e.g., pain and c-fiber stimulation, would be conceivable even if these two properties were one and the same, and thus identical in every metaphysically possible world. To be sure, this is an important component of my argument, for it turns the question as to whether Cartesian intuitions are true into an empirical question. But the reason I give for actually rejecting them is the \textit{further reason} that they are inconsistent with highly plausible scientific and commonsense views. In other words, given the \textit{a priori} possibility that Cartesian intuitions are false anyway, and given that they conflict so radically with other highly plausible views, I conclude that it is more probable that Cartesian intuitions are false. Therefore, since other modal intuitions do not pose the problems that Cartesian intuitions do, there is no reason to think they are false. Or at least nothing in my account supports giving them up. Accordingly, my argument does \textit{not} entail a wide-reaching modal skepticism.

\textbf{THIRD OBJECTION}: Your second reply misses the point for the following reason: you cannot claim that other modal intuitions are to be accepted as true merely because they do not have the same implausible consequences that Cartesian intuitions do. This is because, for a given modal intuition \(m\), the only reason we ever had to think that \(m\) was true was that one could not even in principle see how \(m\) might be false (i.e., we lacked an explanation of how some state of affairs \(p\) could be ideally conceivable while at the same time being metaphysically impossible.) However, in explaining how conceivability can mislead us in a wide-range of cases, this reason has been removed. Therefore, even if other modal intuitions are completely unproblematic, it seems that there are no independent reasons to think that they are true. For all we know, they are false too.

\textbf{THIRD REPLY}: This objection argues that in explaining how it is \textit{a priori} possible for the conceivability-possibility principle to be false, we have removed the central support for treating conceivability as an accurate guide to metaphysical possibility in any case. For example, the worry is that the only reason to think that the modal intuition, “it is metaphysically possible to jump 100 ft. high”, is true is that conceivability could not fail to be an accurate guide to metaphysical possibility in such a case. For how could it be? Since we have given an answer to this question, the objection argues that we have incurred the dialectical obligation of motivating other modal intuitions. The challenge is to motivate them in a way that goes beyond merely pointing out that they do not conflict with our scientific and commonsense views.

\textsuperscript{15} In essence, this is the objection Chalmers makes to my kind of account in his (1999).
The first thing to note is that this is not a problem unique to my account. Put otherwise, one cannot hope to avoid this problem simply by rejecting my argument. As I mentioned above, that the conceivability-possibility principle might be false, basically follows from (i) the conceivability/metaphysical possibility distinction, and (ii) the concepts/properties distinction. Since these two distinctions can be motivated independent of my argument, this is a problem for anyone wishing to treat a given modal intuition as true. Therefore, it is not clear that I have any special burden with regards to it. Having said that, one could argue that a wide-range of other modal intuitions should be accepted, not simply because they do not conflict with our current scientific and commonsense understanding of the natural world, but rather because they are actually supported by this understanding. How so? Again, consider the modal intuition that it is metaphysically possible to jump 100 ft. high. This intuition is supported by our scientific understanding of human physiology and the laws of nature. For example, we know that how high a person can jump crucially depends on his leg strength, as well as other features of his physiological makeup. Moreover, we know that this will also crucially depend on the force that gravity exerts on him. Hence, our scientific views actually support the modal intuition that, in a very different world, i.e., one in which humans had sufficiently stronger legs, and the law of gravity was sufficiently weaker, we really would be able to jump 100 ft. high. Therefore, this modal intuition inherits luster from our scientific understanding of the act of jumping; given that the latter is plausible, we should think that the prior is plausible. So not only is there no reason to reject this intuition as false, there are positive reasons to think that it is true. Analogous remarks apply to a wide-range of other cases.16

FOURTH OBJECTION: You accept, then, that a wide-range of other modal intuitions is to be accepted as true. In fact, one might go so far as to say that the only problematic modal intuitions concern consciousness; in every other case, there is good reason to think that they are true. That being the case, it seems that the conceivability-possibility principle is highly motivated.

You have argued that Cartesian intuitions should be rejected as false because they are inconsistent with some highly plausible scientific and commonsense views. But however plausible such views are, they are not necessarily true. For example, while it certainly seems that particles must behave in a uniform way throughout the universe, it is possible that they do not. Or alternatively, while it certainly seems that sensory states can cause behavior, it is possible that they are really epiphenomenal. Therefore, if it turned out that there was a strong reason in favor of accepting Cartesian intuitions as true, these views could be given up. The reliability of all other modal intuitions is a strong reason to accept Cartesian intuitions.

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16 Just to be clear: I am not suggesting that a given modal intuition \( m \) is true when it is supported by science or commonsense; rather, I am suggesting that when \( m \) is supported in this way, we should accept \( m \) as being true. The truth of \( m \) is a completely different question from the reasons we have in favor of accepting \( m \). If \( m \) is true, this is because \( m \) accurately represents a genuinely metaphysical possible state of affairs. However, we can have more or less evidence for thinking that \( m \) is true. The idea here is that when \( m \) is supported by our present scientific theories, we should think \( m \) is true. But when \( m \) is inconsistent with our present scientific theories, as is the case with Cartesian intuitions, we should think \( m \) is false.
Hence, we should simply revise our scientific and commonsense views to accommodate property dualism.

**FOURTH REPLY:** This objection is tougher than the rest. Put simply, it argues that since I am willing to accept that (a) all other modal intuitions are true, I should equally be willing to accept that (b) Cartesian intuitions are true. What is the support for this argument? The reason seems to be that if other modal intuitions are true, then there must be some psychological explanation of why this is the case. More precisely, it seems that there must be some family of psychological mechanisms \( \phi \) such that \( \phi \) tends to produce true modal intuitions. (For example, one might say that \( \phi \) has to do with the way we form concepts of properties.) Consider the alternative: if there is not a psychological explanation in terms of \( \phi \), then given the *a priori* possibility for conceivability to mislead us in such cases, the truth of these modal intuitions would be highly improbable. In other words, if they were true, this would be a matter of pure chance. But that is surely absurd. As such, the objection argues that given the truth of other modal intuitions, it is reasonable to think that \( \phi \) functions to produce true modal intuitions in the case of consciousness as well.

Now there are two ways one might respond to this objection. The first is to deny that (a) is the case. The idea that all other modal intuitions are true, or at least that there are no problems with accepting them as true, presupposes that separability intuitions over natural kinds and their corresponding physical-theoretical counterparts do not falsify the conceivability-possibility principle. Some philosophers reject this: they argue that the separability of, e.g., water and \( \text{H}_2\text{O} \), is ideally conceivable while at the same time metaphysically impossible. The same argument is then made about the whole range of *a posteriori* necessities. While I think this line of response is attractive, I also think that it faces some tough objections. Accordingly, I would like to provide a different response to the fourth objection. Roughly, it goes as follows.

There are significant differences between Cartesian intuitions and all other modal intuitions, even those over the separability of natural kinds and their corresponding physical-theoretical counterparts. More specifically, they involve concepts and cognitive processes that are fundamentally different from the concepts and processes involved with other modal intuitions. Cartesian intuitions involve the exercise of a concept that conceives of an inner, subjective property, and a concept that conceives of an external, objective physical property. Hence they uniquely involve one concept that is tied essentially to the first-person perspective in a way that even other recognitional concepts are not, and another, psychologically distinct concept that is tied essentially to the third-person perspective. The fourth objection argued that we should accept Cartesian intuitions as true because they are plausibly understand as the product of the same family of psychological mechanisms \( \phi \) that tends to produce other true modal intuitions. However, given these unique aspects of Cartesian intuitions, this argument does not appear to be very strong.

One might object that a wide-range of other modal intuitions also involve distinct concepts and cognitive processes. Nevertheless, we are willing to accept them as true. For example, the concepts ‘human’ and ‘jump’ are distinct; they play different roles in our cognitive system. Moreover, the cognitive processes that are involved in conceiving of
humans and those conceiving of jumping are presumably different. But there is every reason
to suppose that the modal intuition, “it is metaphysically possible to jump 100 ft. high”, is
true. Why should the difference between the concepts and processes involved in Cartesian
intuitions be considered more significant than the difference between the concepts and
processes involved in other modal intuitions? More to the point, why should we think that it
is possible for $\phi$ to function in the latter cases so as to produce true modal intuitions but not in
the former? However, this objection crucially underestimates the psychological gap between
the first-person perspective and the third-person perspective. Below, I explain this concept.

It is hardly controversial to assume that there are deep cognitive-psychological, and
therefore neural, differences between the features of brains that make first-person experiences
possible, and the features of brains that make third-person, verbal and theoretical
organization of information possible. This idea is strongly supported by the fact that while the
latter features are well-understood (for example, we can get a computer to perform these
functions), the former remain largely, if not entirely, mysterious to us at present. Therefore,
given these distinct psychological and neural differences involved with the two perspectives,
and consequently, the concepts that are tied essentially to these perspectives, it would be
completely tendentious to assume that Cartesian intuitions do not differ significantly from
other modal intuitions. Or at least a very powerful argument would be needed to show that
these unique aspects of Cartesian intuitions are not important as far as the functioning of $\phi$ is
concerned. As things stand, it seems that one would be justified in treating Cartesian
intuitions as a totally different kind of psychological entity altogether; conceiving of a
sensory property without a brain property, or vice versa, should not even be understood as a
standard case of conceiving, it is a $sui$ $generis$ psychological act. Hence, it seems that one is
justified in accepting all other modal intuitions as true while rejecting Cartesian intuitions as
false: for all we know, Cartesian intuitions are too fundamentally different from other modal
intuitions for the reliability of the latter to generalize to the former. If I am correct, then the
apparent positive support for Cartesian intuitions is removed.

6. Conclusion

In this paper, I explained the challenge that conceivability arguments pose to type-
physicalism, and I outlined how I think the type-physicalist should respond to such
arguments. Conceivability arguments presuppose that conceivability is an accurate guide to
metaphysical possibility; hence, if the separability of, e.g., pain and c-fiber stimulation, is
conceivable, then there is a metaphysically possible world in which these properties actually
come apart. However, I have argued that this is not the only explanation for why such states
of affairs are conceivable. They might be conceivable because of deep psychological
differences between sensory concepts and brain concepts. Given these differences, the
separability of pain and c-fiber stimulation would be conceivable even if these two properties
were one and the same in reality.
Noting that a similar argument might be made about a wide-range of modal intuitions, I argued that Cartesian intuitions should not be rejected for this reason, but rather for the further reason that they are inconsistent with some highly plausible scientific and commonsense views about the physical world and the place of consciousness in that world. These other views are so plausible that, given the possibility for Cartesian intuitions to be false, it is highly probable that they are in fact false. Crucially, one cannot make the same argument about other modal intuitions. Therefore, type-physicalism can have its cake and eat it too: it can justifiably reject conceivability arguments without being committed to a wide-reaching modal skepticism. Conceivability arguments thus have no force against type-physicalism.

References


The Ghost Partner: Joint Imagination in Reenactment

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1. Introduction

Videographical examination of an activity allows one to observe and analyze cognitive processes as they occur in real time. Unlike the static images presented in photographs or the non-visual medium of audio recordings, videotaping is able to integrate body and speech into a dynamic setting. The ability to create meaning amongst ourselves during interaction with one another is a complex process that relies heavily on bodily gestures, discourse tactics, perceptual orientation, and use of objects situated in a constantly changing environment. Much of what really occurs in daily interaction is not initially apparent due to the culturally constituted nature of structuring behavior. With the aid of videotaping technology, I hope to dissect seven seconds of real-time activity to get a glimpse of cognitive occurrences through gesture and speech situated in a real context.

The activity under scrutiny involved a Hapkido instructor, who is wearing a black belt, teaching yellow belt students how to perform a defensive move. Hapkido is a form of mixed martial arts that predominantly focuses on self-defense. Because of the physical nature of martial arts, much of the meaning being constructed is conveyed through emulation of a particular motion. Learning how to perform a defensive move requires partner work, however, since a defensive move requires one participant to play the role of an attacker. Despite this necessary component, there are times when the instructor must show the move by herself, either because there is no one competent enough to perform the activity with her or in order to demonstrate a particular aspect in detail. The instructor’s ability to effectively convey a partner-oriented activity by herself relies on jointly constructed imagination. Examining speech pattern interplay with imaginative reenactment reveals the use of gestures in temporal relationship to speech, highlighting techniques, and defining deictic (give definition/explanation?) terms. Deictic words are “linguistic elements which specify the identity or placement in space or time of individual objects relative to the participants in a verbal interaction” (Hanks 5). In other words, terms such as “here” or “there” have ambiguous referents until placed in the context of the observer and speaker’s situation.
2. Co-gesture speech

Examining the timing of gestures with corresponding speech provides a key insight into the interplay between the functions of gesture and spoken language. Although many gesture-accompanying words occur at the same instance the word is being spoken, the first segment under examination points to a possibly different use of gesture as preceding talk. In the first segment, the instructor advises students on the improper way to pull an attacker:

**Segment 1 (I = instructor)**

<table>
<thead>
<tr>
<th>Line</th>
<th>Time</th>
<th>Who</th>
<th>Talk</th>
<th>Gesture</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>00:17</td>
<td>I</td>
<td>So (0.5) the main <strong>key</strong> thing is to remember (1) don’t</td>
<td>![Gesture Image]</td>
</tr>
</tbody>
</table>

As she says “don’t”, her left arm moves up from the right and down to the left. Her up and down arm action preempts what she wants to say before she explicitly states it eight seconds later. This movement seems especially out of context when line 2 states, “when you’re pulling them around” with a completely different sequence of actions. It is not until much later, at 25 seconds, that the instructor returns to her previous statement and gesture to finish what she began in line 1 with the statement “not up and down”:

**Segment 2**

<table>
<thead>
<tr>
<th>Line</th>
<th>Time</th>
<th>Who</th>
<th>Talk</th>
<th>Gesture</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>00:25</td>
<td>I</td>
<td>(. ) <strong>not</strong> up and down</td>
<td>![Gesture Image]</td>
</tr>
</tbody>
</table>

In this respect, her gesture in line 1 serves to both provide a visual enactment to students of what not to do as well as aid herself in searching for the words to describe it. The students are able to see what not to do without her having to say what it is explicitly. Furthermore, the instructor herself must perform the action to continue her train of thought already started in her explanation. Despite the verbal disfluency seen by an eight second gap between the first time she explains the up and down gesture and the later attempts to clarify her point, the incoherency does not hinder the students’ understanding of what not to do. The actual words to describe the gesture in Segment 2 only serve to confirm what she had said earlier with
action. In this instance, we see co-gesture speech, as the words “not up and down” in Segment 2 serve more to accompany the already implied action of moving one’s arm in line 1 as opposed to functioning as co-speech gesture, since the gesture is leading the words of speech. The instructor’s arm movement in line 1 foreshadows the subsequent explanation.

3. Role Play and the Power of Imagination

In the next segment of explanation following line 1, the instructor tries to explain the proper method of pulling an attacker to the ground in the event that they attack with a punch. She looks down at her left arm and quickly swings it to her left side, while saying, “when you’re pulling them around”:

<table>
<thead>
<tr>
<th>Line</th>
<th>Time</th>
<th>Who</th>
<th>Speech</th>
<th>Gesture</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>00:20</td>
<td>I</td>
<td>(. ) when you’re pulling them around</td>
<td></td>
</tr>
</tbody>
</table>

Here, the instructor reenacts the movements as if she were defending herself from an attacker. In line 2, her arm swings to the left while clenching her left fist as if holding onto the clothes of her attacker, even though there is no attacker. The speed at which she moves her arm in this first swing aids her emphasis on the word “pulling”. This joint physical force of arm movement in conjunction with the stressed verb incites the observing students to conceive of the force of the pull. By acting out the role of the defender, the instructor takes the perspective of the students who are learning the defensive move. In order for the students to understand her role play, they take on what Murphy calls “hypothetical mode”: “that is, purposefully seeing things as if they were something else, imaginary things created with gestures, talk, and objects” (269). Although there is clearly no one being pulled by the instructor, the students can still make sense of what is going on because they take on the hypothetical mode of pretending that she is really pulling someone. Important to note is the notion that the imagination is jointly shared, since extracting meaning from her movements relies both on her acting out the imagination as well as students effectively perceiving the imagined activity.
4. Highlighting Practices

Collaborative imagination becomes a powerful tool in teaching when the instructor can dynamically modify an action to explain a point while the students still perceive it in the hypothetical mode. In the second segment, the instructor repeats the same left arm swing even slower as she states, “pull them straight around so they’ll fall”.

**Segment 4**

<table>
<thead>
<tr>
<th>Line</th>
<th>Time</th>
<th>Who</th>
<th>Speech</th>
<th>Gesture</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>00:23</td>
<td>I</td>
<td>(. pull them (0.5) straight around so they’ll fall)</td>
<td></td>
</tr>
</tbody>
</table>

By slowing down the motion of the swing this second time around, the instructor has segmented the action to allow further clarification of her statement “pull them straight around”. The straightness that she describes can now be highlighted to students. Through the discursive practice of highlighting, “structures or relevance in the material environment can be made prominent, thus becoming ways of shaping not only one’s own perception but also that of others” (Goodwin 31). What appeared to be an arbitrary quick swing of the arm in line 2 actually gains greater specification in line 3 with respect to the direction and arm angle. By slowing down the movement and directing her eye gaze towards the moving arm, she is teaching students to pay greater attention to their arm swing in order to notice the specifics of arm position and movement. The instructor can employ this highlighting technique through her role-play as a defender. In order to pick up on the highlighted task, the students must jointly imagine the activity that she is pantomiming.

5. Defining Deictic References

Following the same method of role-play, the instructor now switches from the defender to acting out the movement of the attacker. As she concludes the statement “pull them straight around so they’ll fall” with “on their back”, she stands up and leans back slightly as she says “on their back”.

Interesting to note is the interplay of acting out the gesture of the attacker while verbally speaking through the perspective of the defender. In the previous two lines, the instructor acted out the role of a defender pulling an imaginary attacker onto the ground while using the referent “them” to refer to the attacker. Looking at line 4, however, the instructor continues to speak from the perspective of the defender who will fall on their back, except that she switches her gesture to match how the attacker will react. As active observers, the students need to be able to distinguish the switch in role in the instructor’s gestures while maintaining the understanding that the term “their” is still referring to the attacker as it did in the previous lines. Deictic terms such as “them” and “their” are defined through various referential practices that make use of “‘recipient design’, which refers to the ways in which utterances are designed with regard to the particulars of the here and now and the specific co-participant” (Hindmarsh, Heath 1866). Recipient design is employed by the instructor who has tailored her explanations with regards to the listener. Because she had previously established the perspective of the defender in both action and words, the assumption is that the referent remains the same despite the change in gestural perspective. Thus, the students are able to make sense of “their” in line 3 as referring to an attacker while observing a change of role.

6. Conclusion

In examining and categorizing how people construct and convey meaning, one becomes aware of the complexity of seemingly natural performances of speech. Even within the eight seconds of video analysis, the informant has already employed a multimodal approach of explaining a defense move to students. With speech, the instructor has instinctually stressed particular words of interest, as apparent in the detailed transcription. In gesture, bodily action not only serves to prompt explanation but can also engage an audience in interactive imagination of role-play. Deictic terms become used and defined by the context of the environmentally situated activity where students and the instructor all have a mutual understanding of what is being referenced. With this in mind, we realize that the ability to carry on interpersonal communication is a daily event involving a multitude of facets that cannot be underestimated.
References


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Shot Structure in Hollywood Film

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Abstract

In film, a ‘cut’ is a transition between two continuous strips of motion picture film, or ‘shots’. These transitions can dissolve one film strip into the next, or be an abrupt stop between the two shots. How cuts have increased in frequency since the beginning of cinema and how their arrangement form structure across groups of shots is the focus of this study. In order to examine this, films were obtained from 3 genres (action, comedy, drama) and 4 years (1945, 1965, 1985, 2005), one film per genre per year. Luminance and color information were digitally sampled and imported into a Matlab-programmed ‘cut detector’ to predict where cuts occurred within the given film. The program detected hard and soft cuts, which were then manually confirmed or rejected. Additionally, ranges of flagged frames were processed to identify missed cuts, resulting in a list of all the frame numbers at which cuts occur in each film. The results show that mean shot length has decreased over the years. Auto-correlation computation of shot length pairs shows that shot pairs are positively correlated, across both variables of genre and year; this reveals that structure is present across groups of shots in the same pattern of shot length sequences. This finding suggests that there is much more structure to narratives and to seemingly intuitively-placed cuts than one may think.

Introduction

Since its introduction, film has come to play a major role in entertainment and popular culture. However, filmmaking has come a long way from its start through constant revision and innovation.

Cinema began with films consisting of a single shot, partially due to technological inconveniences. For example, the initial version of the Kinetograph camera, used during the first several years of film in the late 1890s, was contained in very large and heavy casing. Early cameras lacked a view-finder, which made determining what was actually in the frame largely guesswork, unless frame limits had been previously set by opening up the back of the camera. Additionally, cameras were held on still-camera tripod heads until the creation of the first panning tripod head in 1897.
Single-shot films soon became problematic after the novelty had worn-off. Stories could only be portrayed in real time, and they were short (averaging about 1 min duration in 1990; Salt, 1983), disallowing film makers to employ a complex narrative. A solution to this problem was longer films through the use of transitions between continuous strips of film, or shots.

A cut is a transition between two shots. These transitions can be an abrupt stop between the two shots (a ‘hard cut,’ see Fig. 1A), or can dissolve one film strip into the next (a ‘soft cut,’ see Fig. 1B). Cuts were introduced in the first multi-shot film around 1900 and sharply increased in frequency in 1903. Hard-cuts specifically between scenes increased dramatically from the 1930s through the 1960s, while use of the dissolve peaked in the 1950s and began to decline in the 1960s (Carey, 1974). Films could now be longer, as well as include developed narrative across various locales.

The initial use of cuts was followed by trouble with action continuity across cuts, although solutions were soon devised over time. Because scenes were often too disconnected to be understandable, text screens were placed between scenes to provide a consistent narrative thread. In his book *Film Style and Technology: History and Analysis*, Barry Salt (1983) details how the fireman in Bob, the Fireman is clearly a different fireman across successive shots, despite the text insisting that he is always “Bob.”

Since the beginning of cinema, cuts have continued to increase in frequency. According to Salt (1983), a shorter shot trend emerged by the 1950s and sped-up during the 1960s. As for the past few decades, David Bordwell (2006) explains in *The Way Hollywood Tells It* that cutting rate continues to increase through the 1980s to the 2000s.

As popular as film has come to be over time, few researchers have studied film through a statistical approach. In light of this, we intend to track changes over time in different shot lengths and examine shot length sequences.

**Methods**


To detect cuts, luminance and color information were obtained from films by digitally sampling and importing them into a multi-part Matlab program. This program features a manual feature for cut-detection found to be more efficient than manually processing a film frame-by-frame, and more accurate than using a Cinematics-type program. Cinematics is a program available online that records where cuts occur by having the user click to indicate a
cut as he or she watches a film. Although this program is useful for determining mean shot length, its data are corrupted by reaction time, which makes structure detection problematic. The cost of our Matlab program, however, is that the false alarm rate can be relatively high. Other cut-detection programs without a manual aspect have a hit rate of about .95 and a false alarm rate of about .18, while our program has a hit rate of .99 and a false alarm rate of .002. *Spies Like Us* was manually processed frame-by-frame to provide benchmark data.

The first part of the program saved each frame as a 256x256 pixel jpeg color picture file. Next, each frame was divided into an 8x8 grid. Within each square, 3 10-bin luminance histograms were created, one for each color channel (red, green, blue). The histograms of a given frame were then compared with the histograms of the previous and following frames. The difference between the two comparisons—which we will call acceleration—was noted, averaged across color channels, and saved into an 8x8 array.

In order to detect hard cuts, two statistics are used. The first is the mean of the 8x8 array acceleration values. The second is covariance, or how one of the 8x8 panels of pixels changes with respect to its surrounding panel. High increase in both covariance and mean acceleration denotes what is likely to be a hard cut.

Soft cuts are more difficult to detect and require the use of two properties. First-order entropy of each frame was calculated to check whether pixel distribution was Gaussian. When two images are superimposed, the pixels of the resulting image usually become more Gaussian. Then the monotonic change in luminance over a period of time (6 frames) was checked. If a frame had been flagged for its change in entropy and then met a monotonicity requirement, it was flagged as a soft cut.

After cuts were detected, the next part of the program used a graphics-user interface to present the researcher with a screen of 4 rows of frames, each row featuring a cut. The frames between the end of one row and beginning of the following row presumably belonged to a continuous shot, since cuts were presented in chronological order. The researcher’s task was first to confirm or reject the computer-detected cut within each row. He or she then identified pairs of rows between which a cut may have been missed, if there appeared to be enough discontinuity between the last frame of a given row and the first frame of the next row. Such frames were flagged for use in the next part.

The final part of the program replayed the ranges of flagged frames. After each film clip was played, the researcher was prompted to identify whether a cut was present. If a cut was present, the researcher then navigated through the frames, 1 or 10 frames at a time, to identify where the cut occurred.

The output file provided 2 variables—an array that contained the frame numbers at which all cuts in the film occurred, and an array that contained the length of each shot in seconds and their overall number ((total # cuts) – 1).

**Results**

To explore how film has changed over time, we examined the change in mean shot length across years. Mean shot length was 13.0 sec for 1945 films, 6.8 sec for 1965 films, 4.0
sec for 1985 films, and 4.3 sec for 2005 films (see Fig. 2). A chi square test shows that pattern of increasingly shorter shots is statistically reliable across years, $X^2(6) = 26.40, p < .001$.

To examine structure within film, we looked at shot length sequence across genres by computing an auto-correlation between shot length pairs (see Fig. 3). The lag-1 correlations for films – that is, shot pairs that are 1 shot apart – are .17 for action films, .18 for comedies, and .18 for dramas. All curves fall-off smoothly, with the drama and comedy film curves hitting a negative correlation at lags of 25 and 62, respectively. All curves show a pattern of above chance— action films $z = 8.83, p = <.00003$; comedy films $z = 6.82, p = <.00003$; drama films $z = 5.70, p = <.00003$. Additionally, action films are reliably above comedies, $z = 5.48, p = <.00003$, and comedies are reliably above dramas, $z = 5.93, p = <.00003$.

An auto-correlation was also computed to examine shot length sequence across years (see Fig. 4). The lag-1 correlations for films are .18 for 1945 films, .19 for 1965 films, .18 for 1985 films, and .17 for 2005 films. All curves, except the 1945 film curve, show a pattern of above chance— 1945 films $z = 1.23, p = .12$; 1965 films $z = 5.48, p = <.00003$; 1985 films $z = 8.61, p = <.00003$; 2005 films $z = 8.39, p = <.00003$. Additionally, there appears to be no immediate year effect— 2005 films are not reliably above 1985 films, $z = -2.57, p = .99$; the 1985 films are reliably above 1965 films, $z = 4.58, p = <.00003$; and the 1965 films are marginally above 1945 films, $z = 1.90, p = .029$.

To further examine structure within film, the partial correlations were calculated for shot length pairs across genres (see Fig. 5). For example, at lag 2 where shot length pairs are 2 shots apart, the partial correlations between the first and second shot lengths and that of the second and third shot lengths are factored out, leaving only the partial correlation between the first and third shot lengths. Looking at continuous strings of values that remain above the 95% 2-tailed confidence interval for random data, drama film partial correlation values are positive up to lag 2, comedy films up to lag 4, and action films up to lag 3. All curves show a pattern of above chance— action films $z = 3.06, p = .0011$; comedy films $z = 3.06, p = .0011$; drama films $z = 1.31, p = .095$. Additionally, action films are not reliably above comedy films, $z = 0.00, p = .50$, but comedies are reliably above dramas, $z = 1.31, p = .095$.

Partial correlations were also used to examine shot structure across years (see Fig. 6). Looking at continuous strings of partial correlation values that remain above the 95% 2-tailed confidence interval for random data, 1945 films are positive up to lag 2, 1965 films up to lag 4, 1985 films up to lag 3, and 2005 films up to lag 3. All curves show a pattern of being marginally above chance— 1945 films $z = 1.31, p = .095$; 1965 films $z = 1.75, p = .040$; 1985 films $z = 3.06, p = .0011$; 2005 films $z = 1.31, p = .095$. Additionally, there again appears to be no immediate year effect— 2005 films are not reliably above 1985 films, $z = -2.18, p = .99$; the 1985 films are marginally above 1965 films, $z = 0.44, p = .33$; and the 1965 films are marginally above 1945 films, $z = 0.44, p = .33$. 
Discussion

In the present study, we sought to examine in what ways film has changed over time and explore shot sequence structure. Our findings reveal that mean shot length decreases in more recent films, and that increasing structure is present across groups of shot.

The data confirms David Bordwell’s (2006) claim in his book, *The Way Hollywood Tells It*, that mean shot length decreases significantly across years. Technological advances have played a major part, but this decrease may also shed light on film viewers’ interests. Within a narrative, the shorter the shot length, the more information can be displayed in a given amount of time. The increase in cuts over the years does not seem to overload viewers, and the sharp decrease in mean shot length illustrates that viewers have become quite used to the increase in cuts. Significantly longer shot lengths in older films may explain why the average movie-goer considers these films to be less interesting to watch.

The correlated shot length pairs across both genres and years illustrates that the closer shots are to each other within a film, the more their lengths are correlated. This reveals that structure is present across groups of shots. Further, the positive correlation indicates that it is the same pattern of shot lengths that ripples through a film. The partial correlations reveal how many consecutive shots compose these patterns. This finding is interesting when paired with how film editing is taught. In his book *Cut by Cut: Editing Your Film or Video*, Gael Chandler (2004) instructs how to edit film and video, and states: “Most editors go with their gut more than their head when cutting. You don’t dryly reason out each edit. You use your heart and instinct to cut” (p. 130). However, this intuition appears to be quite structured, and there may be much more to how editors choose to place cuts.

The significantly different correlation curves across genres perhaps reflect how cuts set the pace for a film’s narrative, as dictated by its genre. Shot length sequences may be mirroring the quick motions within action films’ fight scenes, the long dialogues in dramas, and the mix between the two in comedies.

Although there is no immediate year effect, a trend may appear with a larger sample. Change in shot length sequences across years may reflect changes in tastes and film style, often dependent on historical context. In *Film Style and Technology: History and Analysis*, Barry Salt (1983) states that “after the end of [World War II] there began to be an increasing tendency to deal with down-beat subject matter in all the major film-making countries [...]” (p. 287). Similarly, the 1950s sparked innovation in film projection methodology and location choice to combat the commercial decline of American cinema due to the rise of television, and change in subject matter during the 1960s reflected the loss of older viewers.

In terms of future directions, this study serves as preliminary research for a larger study that will sample the top 10 grossing films of every 5 years, from 1935 to 2005. With the present data, there appears to be genre-year interaction for both mean shot length and correlated shot length pairs. With a larger sample we will be able to better examine these trends, look at other genres, and see what other trends emerge.
This study also makes us wonder whether other forms of narrative hold a similar internal structure. We are particularly interested in sentence length within literature. This also places notes in soundtrack and program music in question.

In sum, films appear to hold structure in their shot length sequences, across both genres and years. Films have clearly changed since the introduction of the cut, which calls us to question whether films will continue to change. Shot lengths may continue to decrease, although probably not by too much. Perhaps higher correlations and longer consecutive shot patterns will appear over time, reflecting a continuation of this structural phenomenon.

References


Figures

**Figure 1A.** A ‘hard cut’ separating the end of one shot and beginning of the following shot.

**Figure 1B.** ‘A soft cut’— one shot (girl leaving through door) dissolving into the next shot (view of house).

**Figure 2.** Graph depicting decrease in mean shot length across years.
Figure 3. Autocorrelations, depicting how the closer shot pairs are to each other across genres, the higher the correlation.
Figure 4. Autocorrelations, depicting how the closer shot pairs are to each other across years, the higher the correlation.
Figure 5. Partial autocorrelations, depicting how the closer shot pairs are to each other across genres, the higher the correlation.
Figure 6. Partial autocorrelations, depicting how the closer shot pairs are to each other across years, the higher the correlation.
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