Tacit Knowledge and Spoken Discourse

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BLOOMSBURY
LONDON • NEW DELHI • NEW YORK • SYDNEY

Bloomsbury Academic
An imprint of Bloomsbury Publishing Plc

50 Bedford Square
London
WC1B 3DP
UK

175 Fifth Avenue
New York
NY 10010
USA

www.bloomsbury.com

First published 2013

British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library.

EISBN: 978-1-4411-6102-4

Library of Congress Cataloging-in-Publication Data
Zappavigna, Michele.
Tacit knowledge and spoken discourse / Michele Zappavigna.
p. cm.
Includes bibliographical references.
ISBN 978-1-4411-2840-9 (hardcover) – ISBN 978-1-4411-2383-1 (ebook) –
ISBN 978-1-4411-6102-4 (pdf) 1. Discourse analysis. 2. Silence. 3. Knowledge, Theory of.
4. Conversation analysis. 5. Speech acts (Linguistics) I. Title.
P302.Z36 2013
401′.41–dc23
2012035233

Typeset by Newgen Imaging Systems Pvt Ltd, Chennai, India
Printed and bound in Great Britain

This book is dedicated to three fine men: my grandfather
Allan Roy Horton and
my sons Orlando and Joseph

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Acknowledgements

I would like to acknowledge and thank my PhD supervisor, Professor Jon Patrick, whose generous help and guidance allowed me to complete the thesis upon which this book is based.

1

Tacit Knowledge and Technology

Introduction

Most of us have been in the situation where we have been frustrated by technical discourses, perhaps through an encounter with an Information Technology (IT) helpdesk or when trying to understand the resident technical 'guru'. The language of technologists[1] can be opaque to outsiders. One of the reasons for the impenetrability of 'tech talk' is that technologists hold extensive tacit knowledge about working with technology. This book seeks to uncover this kind of tacit knowledge by probing the grammatical patterns of technologists working in corporate organizations.

Using the discourse of technologists working in three corporate organizations as a case study, the fundamental argument that will be made is that tacit knowledge cannot be divorced from language. Instead, the process of knowing is a process of transforming experience into meaning with language. This perspective arises out of a systemic functional orientation to language and knowledge:

> Instead of experience being construed by the mind, in the form of knowledge, we can say that experience is construed by the grammar; to 'know' something is to have transformed some portion of experience into meaning. (Halliday and Matthiessen 1999: 603)

In order to make this claim I will begin by critically reviewing Polanyi's (1966b: 4) famous assumption that 'we know more than we can tell', which he used to justify the notion that tacit knowledge is ineffable. I will argue that Polanyi's axiom does not account for a sufficiently nuanced view of linguistic communication and that analysing latent grammatical patterns in spoken texts can in fact illuminate tacit knowledge. Linguistics as a discipline is very much

concerned with making visible patterns in language (and thus in experience and knowledge) that are not readily visible to the untrained eye.

This chapter begins by considering Polanyi's Theory of Tacit Knowing (TTK), focusing in detail on his principle that tacit knowledge is ineffable. I will then review how various domains, from philosophy of science, linguistics, psychology to organizational science, have theorized concepts akin to tacit knowledge, employing different kinds of technicality.

The tacit turn away from language

Much of human experience is below-view, unattended to as we operate in the world, but integral to our performance as social creatures. We hold the experiential agility to be at once creative and efficient, to assimilate the novel and the familiar: in essence, to develop expertise. Over human history we have mythologized experts, such as the artisan, the witchdoctor and the physician by culturally locating their knowledge as hidden and unspeakable, in other words, as 'tacit'. Thus it is not surprising that the dominant contemporary research perspective on what has been termed *tacit knowledge* maintains that it cannot be understood in terms of how people communicate with language (Polanyi 1969). This book, however, seeks to demonstrate that analysing latent linguistic patterns in spoken discourse, the kinds of patterns that linguists regularly explore, reveals tacit knowledge.

As a folk term, tacit knowledge has come to be associated with prosodies of meaning relating to silence and the unspoken. *Tacit* originates in the Latin, *tacitus*, meaning silent. Its synonyms refer to ineffability (e.g. *unsaid*, *unspoken*, *unuttered*, *wordless*, *silent*, *undeclared*, *unexpressed* and *unvoiced*) and to indirectness (e.g. *implicit*, *implied*, *inferred* and *understood*). Antonyms of tacit include *explicit* and *expressed*. These folk meanings about linguistic inexpressibility have directed research away from investigating how tacit knowledge might be manifest in language patterns. We should, however, consider whether silence is an attribute of tacit knowledge or an artefact of our lens.

The researcher attributed with coining tacit knowledge as a technical term is Michael Polanyi, though the general concept of practical knowledge can be traced at least as far as Aristotle's notion of *phronesis*. While Polanyi may have introduced tacit knowledge into scholarly discourse, *tacit knowing* was his preferred term for the act of 'tacit integration' that his theory developed to explain the experience of knowing something. This conceptual position,

casting knowing as a process rather than an object, (knowledge) is in accord with the movement in disciplines such as semiotics and linguistics away from a constituency-based view of meaning, towards a view of meaning as 'in the making' as we construe our experience of the world.

Polanyi's TTK introduced a post-critical perspective on what it means to know, arguing that personal judgement characterizes knowledge claims even in disciplines such as the sciences that assert their objectivity. Despite his claim that 'all knowledge is either tacit or rooted in tacit knowledge' (Polanyi 1969: 144), most studies drawing on TTK presuppose a dichotomy of tacit and 'explicit' knowledge. Indeed, the impetus to classify human knowledge as either tacit and intuitive, or conscious and experiential, has ancient pedigree. For example, Basque, the oldest language of Europe, originating some 7,000 years ago, distinguishes between knowing intrinsically (*ezagutu*) and knowing by learning (*jakin*).

Before exploring TTK, I will deal with Polanyi's most famous axiom regarding the ineffability of tacit knowing since it is the principle that this book seeks to reconsider. The intent is not to invalidate TTK but to show how employing linguistic theory in conjunction with Polanyi's work can extend our insight into tacit knowledge. As we will see in the chapters that follow, consideration of the complexities of human meaning-making, using a functional, stratified model of language can extend Polanyi's theory and show that there are patterns in what we say that can give us further clues about tacit knowing.

The ineffability principle: What does it mean 'to know more than we can tell'?

One of the central tenants of Polanyi's TTK is that tacit knowledge cannot be articulated. Instead it is a form of ineffable knowledge which is not expressed through language but rather lived through experience:

> I shall reconsider human knowledge by starting from the fact that we can know more than we can tell. This fact seems obvious enough; but it is not easy to say exactly what it means. Take an example. We know a person's face, and can recognize it among a thousand, indeed among a million. Yet we usually cannot tell how we recognize a face we know. So most of this knowledge cannot be put into words. (Polanyi 1966b: 4)

The claim that 'we can know more than we can tell' is an argument that tacit knowledge is not carried in language. It positions ineffability as a criteria for

asserting the epistemological significance of knowledge of which we are not intentionally aware. According to the principle of ineffability, an identifying attribute of this knowledge is its a-linguistic instrumentality since while 'the expert diagnostician, taxonomist and cotton-classer can indicate their clues and formulate their maxims, they know more than they can tell, knowing them only in practice, as instrumental particulars, and not explicitly, as objects' (Polanyi 1958: 88).

However, it important to carefully consider what it means *to tell* in theorizing how we might know more than can be told. If *telling* means directly 'transferring' information to the mind of the listener, then this it is not a possible means for exposing tacit knowledge. This impoverished view of communication has been characterized by Reddy (1979) as employing a conduit metaphor whereby words are boxes with meanings inside that we send to other people. As Reddy (1979: 287) has noted with the following examples of lexical metaphor, the metalingual resources of English privilege this kind of view:

> Whenever you have a good idea practice capturing it in words.
>
> You have to put each concept into words very carefully.

If, however, we allow that *telling* involves negotiating meanings that are latent in the often implicit patterns of spoken discourse (and in turn subject to the interpretation of the listener), linguistic communication is reinstated as relevant to understanding tacit knowledge. Our account of telling should also allow for language to be considered as a social practice, being used as it is to enact the various genres that constitute social life.

The view of language characterized by the conduit metaphor is not a view that Polanyi would have condoned. Despite his claims about ineffability, Polanyi had a lot to say about language and, as I will cover later, developed a theory of 'sense-making and sense-giving' (Polanyi 1967). Given that Polanyi's thesis about 'personal knowledge' was aimed at undermining the notion that science deals in objectivity, it is unlikely that TTK intended to adopt this kind of mathematical model of communication. Indeed TTK acknowledges that language use is itself tacit to the knower rather than an object ready to be transferred to someone else's head:

> While language expands human intelligence immensely beyond the purely tacit domain, the logic of language itself – the way language is used – remains tacit. (Polany 1966a: 7)

However, and importantly, Polanyi's model neglects the very significant point that the field of linguistics has developed many tools for describing the complex

patterns that can be uncovered in discourse and that these tools can make these tacit patterns visible. While Polanyi's theory involves contemplating meaning, it does not acknowledge the role that linguistics and semiotics can play in exploring tacit language patterns. In theorizing tacit knowledge as unable to be communicated in language, Polanyi has factored out the power of linguistics to describe and explain what Polanyi terms 'the tacit coefficients of language' (Polanyi 1958).

Nevertheless, Polanyi's concept of knowing more than one can express in language has been taken up by theorists in a variety of disciplines with vigour. The enthusiasm has meant that the opportunity that linguistic analysis affords in giving us greater insight into the nature of tacit knowledge has been obscured. The strong standpoint on ineffability is a superficial reading of Polanyi's theory. Rather than arguing that one cannot speak at all about tacit coefficients, Polanyi focuses on the 'adequacy' of representation:

> To assert that I have knowledge which is ineffable is not to deny that I can speak of it, but only that I can speak of it adequately, the assertion itself being an appraisal of this inadequacy. (Polanyi 1958: 91)

Explicit maxims that attempt to encapsulate or explain the craftsman's practice are limited in their utility as 'these never disclose fully the subsidiary known particulars of the art', that is, they do not adequately represent the object of subsidiary awareness (Polanyi 1958: 90).

Polanyi's arguments about knowing and telling separate knowledge and language. A functional approach to language, however, suggests that it does not make sense to distinguish between knowledge and language in the same way that it does not make sense to distinguish between language and thought (Butt 1985). Relevant to this perspective, is Douglas's account of the misleading nature of the verb 'to express':

> That word establishes a distinction between the expression and that which is expressed. The object of our study discloses no such cleavage. Knowledge is a continuous process of realization involving both the implicit and the explicit. (Douglas 1975: 8)

This 'continuous process of realization' can be modelled by looking how meanings are realized in language. We may articulate what we know tacitly through patterns and features of language to which we do not directly attend. This is an argument that articulation is not the equivalent of codification. It is the work of the discourse analyst to uncover the implicit meanings that are made in spoken texts, affording the potential for these implicit patterns to be celebrated or, where

they may be impeding some social process, offer suggestions on how they might be changed (see for example the extensive tradition in Systemic Functional Linguistics (SFL) of making explicit the language patterns of pedagogic discourse so that classroom teaching might be improved; summarized in Rose 2012).

Part 1: Introducing Polanyi's TTK

TTK draws upon the perspective on human perception afforded by Gestalt psychology. In particular, it references the Gestalt idea of perceiving the whole while not being aware of the particulars. Two levels of awareness are presented as central to tacit knowing: focal awareness and subsidiary awareness. These are mutually exclusive states distinguished by the nature and degree of attention deployed: focal awareness is conscious, while subsidiary awareness is below-view. Polanyi (1969: 212) illustrates how these two systems of awareness operate with the example of stereovision. A person looking at a stereoscopic image is focally aware of the integrated stereoscopic image but has only subsidiary awareness of the two slightly different images that each eye sees. The knower integrates the differences in the two stereo images to form a joint visualization that has spatial depth. Such a process of integration is the fundamental configuration of tacit knowing and termed, *tacit integration*.

Tacit integration is the basis of our capacity to perform skilful action. For example, when hammering a nail 'I have subsidiary awareness of the feeling in the palm of my hand which is merged into my focal awareness of my driving the nail' (Polanyi 1958: 55). The structure of such integration is likened to the proximal–distal relation in anatomy figured as the unusual construction of attending *from* something *to* something else:

> Such is the functional relation between the two terms of tacit knowing: we know the first term only by relying on our awareness of it attending to the second. (Polanyi 1966b: 10)

In this way, the functional structure of tacit knowing, that is, the act of integrating subsidiary clues and a focal object, is directional since in 'subordinating the subsidiary to the focal, tacit knowing is directed from the first to the second' (Polanyi 1969: 141). It is.

Subsidiary awareness is further specified by TTK as incorporating two kinds of clues: *subliminal* or *marginal* (Table 1.1). On the one hand there are things that a knower cannot directly perceive. These subliminal clues include any of the

Table 1.1 Types of awareness in Theory of Tacit Knowing

Type of awareness	Nature
Subsidiary	
Subliminal	Knower cannot directly perceive object
Marginal	Knower could perceive object if it were the focus of their attention
Focal	Knower can perceive object directly

neurophysiological bases of perception such as eye muscle contraction. On the other hand there are things which the knower could perceive if they were the focus of attention. These are marginal clues such as objects in the periphery of a knower's field of vision.

While subsidiary awareness appears to loosely correspond to the popular conception of the unconscious,[2] TTK is careful to distance it from this common-sense view, reiterating that, as a form of awareness, it must be considered in terms of the to–from structure at the heart of tacit knowing:

> If this analysis convinces us of the presence of two very different kinds of awareness in tacit knowing, it should also prevent us from identifying them with conscious and unconscious awareness. Focal awareness is, of course, always fully conscious, but subsidiary awareness, or from-awareness, can exist at any level of consciousness, ranging from the subliminal to the fully conscious. (Polanyi and Prosch 1977: 39)

In this way, the model of awareness does not equate with models of the subconscious, preconscious, 'or with the fringe of consciousness described by William James'. Instead, TTK casts the functional structure of tacit knowing as a form of logic similar to drawing inferences from a premise, the difference being that the inferences drawn by tacit knowing are not explicit.

Indwelling and interiorization

TTK posits knowing as an act of 'personal participation' involving the body (Polanyi and Prosch 1977: 73). The term *indwelling* is used to describe the active participation of the knower and their body in the process of tacit integration. For example, subliminal subsidiary awareness in the form of neurophysiological reaction to stimulus is a form of indwelling experienced by a knower but not attended to at the level of focal awareness. Both sensory perceptual experience

and internal bodily functioning that is not part of our direct experience are encompassed by subsidiary awareness. Knowing is cast as an *interiorization* with meaning being made by dwelling in something rather than merely looking at it. We experience via subsidiary awareness something not as solely itself, but as its relation to a more comprehensive entity. For example, indwelling is central to performing and learning a skill:

> Two kinds of indwelling meet here. The performer co-ordinates his moves by dwelling in them as parts of his body, while the watcher tries to correlate these moves by seeking to dwell in them from the outside. He dwells in these moves by interiorizing them. By such exploratory indwelling the pupil gets the feel of a master's skill and may learn to rival him. (Polanyi 1966b: 30)

This is a view of knowledge as embodied whether the skill is physiological or semiotic. Indwelling is at the centre of both everyday perception and complex scientific theorizing: a dancer dwells in a dance just as a chemist dwells in an experiment.

The tacit coefficients of language: The structure of meaning in tacit knowing

Polanyi developed an account of 'sense-giving and sense-reading' where he set out to outline 'the total structure of language, comprising both its formal patterns successfully established by modern linguistics and its informal semantic structure, studied so far mainly by philosophy' (Polanyi 1969: 181). Nevertheless his work on language has largely been ignored by theoretical and applied linguists (Tóth 2008). As I flagged earlier, there are many references to 'meaning' in TTK that a functional linguist might find promising, particularly in their appeal to the experiential rather than to logical formalism. Polanyi specifies tacit knowing as a process of making meaning without which consciousness is not possible:

> All human thought comes into existence by grasping the meaning and mastering the use of language. Little of our mind lives in our natural body; a truly human intellect dwells in us only when our lips shape words and our eyes read print. (Polanyi 1969: 160)

Making meaning is an active process involving the two forms of awareness (focal and subsidiary) introduced in the previous section. These forms of awareness are described by TTK in terms of how they function semiotically:

> It is our subsidiary awareness of a thing that endows it with meaning: with a meaning that bears on an object of which we are focally aware. A meaningful relation of a subsidiary to a focal is formed by the action of a person who integrates one to the other, and the relation persists by the fact that the person keeps of this integration. (Polanyi 1969: 182)

In figuring tacit integration as producing relations in meaning, Polanyi is essentially suggesting that tacit knowledge is a semiotic act. It therefore seems entirely at odds with the TTK to argue that tacit knowledge is not carried in language when we speak, particularly as Polanyi goes on to specify three types of linguistic meaning that involve tacit integration: words functioning as indicators, as symbols and as metaphors. Perhaps this failure to fully account for the possibilities that understanding grammatical patterning might afford in understanding tacit knowledge results from the fact that this linguistic description is undertaken solely at the word level without factoring in the power of linguistic stratification. Another problem may be that Polanyi is employing a model of meaning as external to language, a kind of 'transcendent' model of semiosis that figure meanings as outside the linguistic system:

> . . . as reference, meaning as idea or concept, meaning as image. These notions have in common that they are 'external' conceptions of meaning; instead of accounting for meaning in terms of a stratum within language, they interpret it in terms of some system outside language, either the 'real' world or another semiotic system such as that of imagery. (Halliday and Matthiessen 1999: 416)

By way of contrast the functional approach adopted in this book sees meaning as realized in language, that is, as 'something that is constructed in, and so is part of, language itself' (Halliday and Matthiessen 1999: 416).

According to TTK, linguistic reference utilizes the 'from–to' structure of tacit integration with words functioning as 'indicators, pointing in a subsidiary way to that focal integration upon which they bear' (Polanyi and Prosch 1977: 70). Other kinds of signs such as road signs and mathematical formulae may function like denotative words as subsidiary indicators of meaning:

> . . . they have in common with these words that, when they are viewed in themselves (not as they appear to us when they are serving their function of bearing on something else), there is little interest to be found in them. (Polanyi and Prosch 1977: 70)

Polanyi employs the following notation to describe the to–from relation, where S is a subsidiary clue, F is the object of focal intent and the arrow represents the relationship of 'bearing upon':

$$S \rightarrow F$$

For example, S might be a particular word which, according to the way TTK theorizes meaning, is in itself is not of 'intrinsic interest' to the knower. The word is endowed with meaning once it serves its 'function of bearing upon something else' (Polanyi and Prosch 1977: 70). The general class of this type of relation is defined as the following, where +ii is 'our intrinsic interest' and –ii represents those clues that are not of intrinsic interest:

$$\begin{array}{cc} +ii & -ii \\ S & \rightarrow F \end{array}$$

Consider the example of a blind man operating a cane to navigate. The potentially dangerous objects that he encounters with the stick are the focal objects (F), while the feelings he experiences in his hand as the cane hits an object are subsidiary clues (S) that he integrates with the focal object to draw his conclusions about the safety of his path. Polanyi suggests that this is a 'self-centred integration' as it relies upon the indwelling of the self, attending 'from' subsidiary clues 'to' the focal object (Table 1.2 shows 12 examples of other self-centred integrations that he provides).

Table 1.2 Self-centred integrations involving clues lacking the intrinsic interest of the focal object

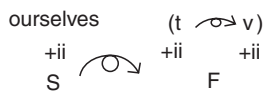
Kinds of self-centred integration
Sensory clues fused to perception
Two retinal images fused to three-dimensional sight
Two stereo pictures fused to three-dimensional sight
Deliberate motions fused to intended performance
Actions taken in causing something to happen
Establishment of part-whole relations
Structure of a complex entity, e.g. a physiology
Series of integrations forming a stratification
Use of clues to establish reality of a discovery
A simulation identified with a simulated object
Recognition of a member of a class
Use of a name to designate an object

The next class of words considered is where they function as symbols, rather than as indicators of other things. Instead of being outside our interest, 'it is the subsidiary clues that are of intrinsic interest to us, and they enter into meanings in such a way that we are carried away by these meanings' (Polanyi and Prosch 1977: 71). The focal object is of interest to us because of its symbolic relation to the subsidiary clues. Hence the + and – symbols used in the notation for symbolization are the inverse to indication. For example, in the case of a flag, the subsidiary object is the person's cultural experience of living in the particular country and 'we, as selves, are picked up into the meaning of the symbol' (Polanyi and Prosch 1977: 73). The looped, 'somersaulting' arrow used in the notation below represents the involvement of our embodied, personal experience (as people living in a country) in our understanding of the symbol. The notation is intended to capture the idea that it is 'a wholistic achievement imaginative achievement of meaning, not a serialized mechanical one':

On the other hand, an example where S and F are both of intrinsic interest to the meaning made is metaphor. This is the case where 'a symbol embodying a significant matter has significance of its own and this is akin to the matter that it embodies' (Polanyi and Prosch 1977: 78). In other words, the target of the metaphor and its vehicle are both significant:

> The tenor bears on the vehicle, but, as in the case of a symbol, the vehicle (the focal object) returns back to the tenor (the subsidiary element) and enhances its meaning, so that the tenor, in addition to bearing on, also becomes embodied in the vehicle. (Polanyi and Prosch 1977: 78)

The view of metaphor proposed may be seen as a misreading of Richards' (1936) conception that tenor and vehicle are integrated in metaphor to produce a new meaning rather than the vehicle being a focal object (Gulick 1993). This may be notated as follows, where t (tenor) and v (vehicle) are given as:



It is because of the involvement of ourselves in the meaning of a metaphor that we experience the emotional response so integral to its use in poetry and other written art.

The account of meaning provided by Polanyi is very different to the Saussurean and Firthian-inspired model that developed into SFL, the account of language deployed in this book. Polanyi's focus on words factors out the other strata of language (context, discourse-semantics, phonology/graphology). In so doing it factors out the interpersonal, social dimension of meaning. Meaning is more than a relation between different kinds of attentive states, it is a way of getting things done in the social word, and is in this sense a social semiotic (Halliday 1978). There is, however, some alignment between a functional and Polanyian perspective with both descriptions figuring meaning as experience rather than as formal logic. Nevertheless, making meaning with language involves construing experience, interacting with others and organizing these two dimensions (Halliday (1978) theorizes these functions of language as metafunctions explained in Chapter 2). Polanyi's account of attention in relation to words does not adequately address these kinds of functions of language.

Tacit semiosis: Translating tacit integration into peircean semiotics

In *Knowing and Being*, a collection of essays, Polanyi (1969) translates TTK into the technicality of Peircean semiosis. Semiosis is a term used in semiotic theory to describe the making of meaning with signs. Peirce's semiosis posits a triadic relation between a sign, interpretant and object in an account that emphasizes the relational and perspectival nature of representation. A sign is 'grounded' by the interpretation of the entity that perceives it:

> A sign, or representament, is something which stands to somebody for something in some respect or capacity. It addresses somebody, that is, creates in the mind of that person an equivalent sign, or perhaps a more developed sign. That sign which it creates I call the interpretant of the first sign. (Peirce et al. 1931).

Peirce's claim that the meaning of a sign is mediated by further signs is a rejection of the notion of immediate access to 'understanding' and in this way is aligned with Polanyi's critique of scientific objectivity. Figure 1.1 depicts the mediating role of the interpretant in a triadic conception of signification (meaning-making).

Polanyi (1969) translated his ideas about tacit integration into the terms of Peircean semiotics, possibly to further specify the way he conceived tacit knowing to be an active process of making meaning. The triadic relation between

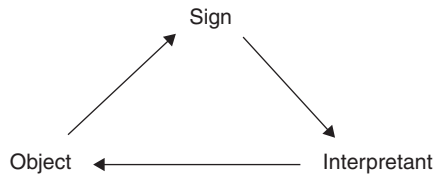


Figure 1.1 A triadic conception of semiosis.

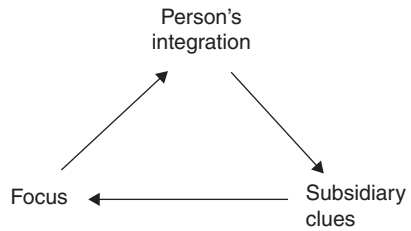


Figure 1.2 Tacit integration represented in terms of Pierce's triadic semiosis.

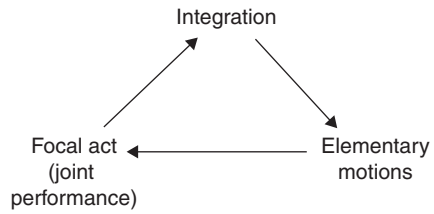


Figure 1.3 The tacit integration of a skill.

an object, an interpretant and a sign posited in Peircean semiosis is presented in Figure 1.1. Polanyi's concept of subsidiary awareness, when translated into the Peircean model, becomes the interpretant, that is, the socially situated consciousness of the 'knower' (see Figure 1.2). This representation accords with the idea that the social and cultural influences on our meaning-making are often below our attention.

For example, the tacit integration of a skill can be represented using the Peircean triad as in Figure 1.1. Polanyi (1969: 183) argues that 'the major skills of our body and mind are all based on a meaningful integration of our body and of sensations felt by our body'. The elementary motions that are integrated to perform the skilful action are subsidiary in the sense that the performer does not attend to them. Thus they are placed in the position occupied by the interpretant in Figure 1.1. These elementary motions are integrated with the focal act (Figure 1.3). In this way, Polanyi argues that an action with our bodies, such as riding a bike, is skilful because physical action involves the integration

of subsidiary elements that are interiorized by the subject. External objects are made internal to the body in the process of tacit integration, here rewritten as 'tacit semiosis'.

Such subsidiary sensing figures meaning as internalization, that is, rendering meaning-making as the integration of subsidiary and focal elements (Polanyi 1969: 183). Things of which we are not directly aware, being subsidiary to our attention 'resemble our body closely by the fact that we rarely know them focally' (Polanyi 1969: 183). For example, consider Figure 1.4 which depicts tacit integration in navigating blindfolded with a stick. In this case, the impact that the stick makes on the hands and fingers of the knower is part of their subsidiary awareness and this is integrated with the position of the object where it is hit by the stick. The integration allows the knower to assess potential hazards in the environment and navigate the space.

Figure 1.5 depicts tacit integration in the speculative skill of deciding a chess move. Here the knower integrates the potential moves of chess-men, the entire scope of which he does not readily have conscious access to at once, with the chess-men that he is focusing on moving.

Polanyi suggests that the Peircean triad, with subsidiary perception added for the case of tacit knowing, is directly applicable to fields such as zoology and botany. In these fields understanding the characteristic appearance of biological phenomena is 'based on features that are hardly identifiable in themselves' (Polanyi 1969: 184). Figure 1.6 portrays the tacit integration of reading a physiognomy, an example of how integrating clues or features imbues meaning

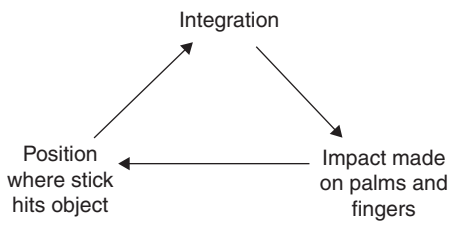


Figure 1.4 Tacit integration in navigating blindfolded using stick.

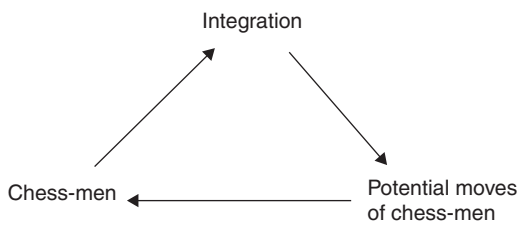


Figure 1.5 Tacit integration in a speculative skill: deciding a chess move.