Commentary/Stoffregen & Bardy: On specification and the senses

A modality-neutral perspective could account for multimodal perception without requiring internal mediation across modalities. A type of information (e.g., inverse rate of change information for time-to-arrival, time-varying kinematic pattern information for speech articulation) can be instantiated as structure in multiple arrays (visual; auditory), but perceiving is concerned with the information, not the energy array in which it is available. In this sense, “cross-modal” integration is not something that occurs in the animal, but occur in – and as a property of – the information itself. This would be true whether the specifying structure exists within a range of energy detectable by a single sensory system, or across a range of energy detectable only by multiple sensory systems. Specificity is general.

We feel that much of the neurophysiological and behavioral evidence cited by S&B are also supportive of a modality-neutral account (e.g., Fitzpatrick et al. 1994; Stein & Meredith 1993). The same seems true of recent neuropsychological and behavioral findings on audiovisual speech perception. Recent brain imaging research shows that visual speech can change auditory cortex activity during audiovisual integration and even silent lipreading (Calvert et al. 1997; Sams et al. 1991). Also, mounting perceptual research suggests that the audiovisual streams are integrated very early, possibly at the level of information extraction (see Green 1998, for a review). The sensitivity to modality-neutral information also seems to occur at a very young age. Infants detect audiovisual correspondences in phonemic properties (Kuhl & Meltzoff 1984), and portray McGurk-effect-like behavior (Rosenblum et al. 1997). These latter findings should also be encouraging to S&B: they suggest that sensitivity to the specificity existent across modalities is a fundamental perceptual ability.

But what of the McGurk effect itself? Would not the global array concept explain how a /d/ could be perceived from the concurrent visual specification of /g/ and auditory specification of /b/? In fact, here we must tip our hats to S&B: it is likely that the resultant perceived /g/ is specified in the structure existent across optic and acoustic arrays. For an ecological explanation of the McGurk effect, the global array could save the day. However, contrary to S&B, we do not think that the global array can provide information about the experimental manipulation itself. It is unclear what type of perceptual exploration might reveal the audiovisual discrepancy, short of seeing the audiovisual dubbing procedure. Furthermore, research shows that it makes little difference whether subjects are asked to report “ what was said” or “ what you heard”: audiovisual influences still occur (e.g., Massaro 1987). We find the inability of the global array to specify the McGurk manipulation encouraging: Perceptual encapsulation evidences the lawful nature of informational specification.

In conclusion, we think S&B have posed an important challenge to S&EB: it is likely that the resultant perceived /g/ is specified in the structure existent across optic and acoustic arrays. For an ecological explanation of the McGurk effect, the global array could save the day. However, contrary to S&B, we do not think that the global array can provide information about the experimental manipulation itself. It is unclear what type of perceptual exploration might reveal the audiovisual discrepancy, short of seeing the audiovisual dubbing procedure. Furthermore, research shows that it makes little difference whether subjects are asked to report “what was said” or “what you heard”; audiovisual influences still occur (e.g., Massaro 1987). We find the inability of the global array to specify the McGurk manipulation encouraging: Perceptual encapsulation evidences the lawful nature of informational specification.

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NOTE
We prefer the term modality-neutral over “amodal”: while perceptual information is not modality-specific, it cannot exist without instantiation in some energy array (excepting ESP).

Specificity is always contingent on constraints: Global versus individual arrays is not the issue

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Abstract: Stoffregen & Bardy’s proposal that perceptual systems can use information defined across two or more sensory domains is valuable and urgent in its own right. However, their claim of exclusive validity for global-array information is superfluous and perpetuated for incorrect reasons. The seeming ambiguities of individual arrays emanate from failures to consider relevant ecological constraints and higher-order variables.

James Gibson’s (1950; 1966; 1979/1986) demonstrations of specificity and the associated refutation of the ambiguity dogma were made possible by two brave intellectual advances: Gibson recognized that useful information could reside in higher-order properties of the ambient arrays (a breakaway from elementarism) and, furthermore, that by restricting analyses to natural conditions a wealth of meaningful and reliable information could be brought in evidence. The latter amounts to an invocation of ecological constraints, in addition to the laws of nature.

Stoffregen & Bardy’s (S&B’s) proposal that relevant information can reside in a global array extending across energy array borders falls well within Gibson’s approach in the first respect. If useful specifying variables can consist of relational properties across a single array and over time, it follows naturally that they could also extend over two or more types of energy arrays. Thus, S&B’s proposal of a search for global invariants is laudable as such, as is their claim that properties specified by such invariants could be directly perceived. This enterprise gains urgency from the recognition that the senses operate simultaneously and that information from different arrays is often necessary for the control of action.

However, S&B not only proffer global invariants, they also make extensive claims that specificity occurs exclusively with such invariants. We disagree, and argue that S&B’s failure to find specification in individual arrays follows from their failure to apply Gibson’s insights concerning ecological constraints and non-elementarism. The groundbreaking contributions by Gibson and others concerning information in individual arrays should remain a valid basis for perception research.

Ecological constraints. All specificity is contingent on constraints (“constraints as grantees of information,” Runeson 1988; 1989; cf. Barwise & Perry 1953). Moreover, the specificity they endeavor pertains to properties, not the structures or media as such (cf. Bingham 2000b; Turvey 1992). Potentially, constraints can be any lawfulness or regularity, ranging from laws of nature, via ecological universals such as textured environmental surfaces to, say, local conventions. Thus, relations of informative specificity vary in degree of universality depending on the scope and stability of the constraints that grant them.

It follows that specificity can not be meaningfully investigated without acknowledging the questions: specification of what properties, under what conditions? Without restricting analyses to particular properties and conditions, specificity will be hard to find. We question the relevance of universal, unconstrained deliberations on specificity for the understanding of perception and action.

Apparently S&B do not consider the role of constraints in their discussion of specificity. Thus, we are not impressed when they take the hypothetical existence of perfect virtual-reality devices to prove optic array ambiguity. To be consistent, they should also have considered the possibility of slightly more complicated devices as proof against specificity in the global array. What if light...
would not propagate linearly? What if an evil genius were distorting arrays? If one allows such arguments there will always be reasons to reject specificity (cf. Dretske 1981).

An ecological stance does not proffer specificity because injection of yet higher order variables can outweigh such arguments, but because it dismisses non-ecological circumstances as irrelevant. Constraints at the ecological level grant specificity to informative variables, whether single- or multi-array. It is biologically irrelevant whether a variable that specifies a useful property of the organism-environment system is granted by ecological constraints or by physical laws alone.

Culture and technology add and break constraints. Traffic lights add specification of safe street crossing. Conversely, virtual-reality gear and swinging rooms deliberately break a basic ecological constraint by decoupling the visible environment from the earth and thus makes the optic array lose some of its specificity. Inadverent cases also occur, as in elevators. This presents new possibilities and challenges to perceivers. Will they be able to educate their attention to detect other information – in the global array – that specifies the new situation? Interestingly, the success of virtual-reality technology will rely on people's failure to do so.

Non-elementarism. S&B's failure take advantage of Gibson's nonelementaristic approach is evident in their dismissal of somatosensory specificity concerning body sway versus tilting of the surface of support: Ankle rotation can be due to either of them. However, in many other somatosensory variables, the two events have distinct effects. For instance, standing on a slanted board produces force components parallel to the surface with corresponding shearing skin deformations, varying in proportion to the angle of tilt. Conversely, sway produces alternating shifts between heels and toes in the perpendicular skin pressure component. Amplitudes and directions of ankle joint load forces will also differ distinctly. Somatosensory ambiguity has certainly not been demonstrated.

S&B's claim that the acoustic array can only specify relative motion between other cars and one's own is similarly vacant. One can hear quite a bit about how one's own car is moving, in particular whether it is moving or not. The acoustic array is structured by reflection and occlusion of sounds among cars on the road and among terrain features. These multididuous effects are a potential source of informative variables in the acoustic structure, which S&B have dismissed offhand.

We do not claim that we have shown or can show that specificity exists in those cases. Our point is that S&B have not provided any proof for the claimed ambiguities. In principle, ambiguity in natural arrays is not the kind of thing that can be proved, because there is no way to ensure that all possible higher-order variables have been tried and all relevant constraints have been considered for their information-granting potential (Runeson 1988). Ambiguity could become a tenable claim only after long and hard attempts to prove specificity have failed.

Finally, we notice that S&B's reasoning is remarkably congruous with that of the classical, no-specification tradition. The possibility of specification is brushed very lightly, often by letting a single variable (mis-)represent the informative potential of a whole energy field. With non-specificity seemingly proved, a case is made for the standard remedy: invocation of something more. Traditionally, the recourse has been to memory and constructive inference – S&B instead bring in additional sensory domains as remedial necessities.

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NOTE

1. It would be tempting to call this reasoning of S&B's "pre-Gibsonian," however, also Gibson (1966, pp. 82f) failed to consider the shearing force component. When related to the perpendicular component it specifies slant of the surface of support without recourse to gravito-inertial information.

Perceptual systems: Five+, one, or many?

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Abstract: The target article's value lies not in its defence of specification, or the "global array" concept, but in its challenge to the paradigm of 5+ senses, and its examples of multiple receptor types cooperatively participating in specific pick-up tasks. Rather than analysing our perceptual endowment into 5+ senses, it is more revealing to type perceptual systems according to task.

S&B's claim that the acoustic array can only specify relative motion between other cars and one's own is similarly vacant. One can hear quite a bit about how one's own car is moving, in particular whether it is moving or not. The acoustic array is structured by reflection and occlusion of sounds among cars on the road and among terrain features. These multididuous effects are a potential source of informative variables in the acoustic structure, which S&B have dismissed offhand.

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