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Typecasting and Legitimation: A Formal Theory*

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Abstract

We develop a unifying framework to integrate two of organizational sociology's theory fragments on categorization: typecasting and form emergence. Typecasting is a producer-level theory that considers the consequences producers face for specializing versus spanning across category boundaries. Form emergence considers the evolution of categories and how the attributes of producers entering a category shapes its likelihood of gaining legitimacy among relevant audiences. Both theory fragments emerge from the processes audiences use to assign category memberships to producers. In this paper, we develop this common foundation and clearly outline the arguments that lead to central implications of each theory. We formalize these arguments using modal expressions to represent key categorization processes and the theory-building framework developed by Hannan, Pólos, and Carroll (2007).

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Categorization in market contexts has attracted considerable interest in recent years, spurred in large part by Zuckerman's (1999) seminal work in capital markets. Empirical work on this subject covers a range of topics, including category emergence, proliferation, and erosion (Carroll and Swaminathan 2000; Ruef 2000; Rao, Monin, and Durand 2005; Bogaert, Boone, and Carroll 2006; Pontikes 2008), the consequences of different categorical positions and category structures for individual producers (Zuckerman and Kim 2003; Hsu, 2006; Negro, Hannan, and Rao 2008; Hsu, Hannan, and Koçak 2008), and the role of audience members in structuring understanding of categories (Boone, Declerck, Rao, and Van Den Buys 2008; Koçak 2008; Koçak, Hannan, and Hsu 2008).

This paper focuses on two theory fragments, typecasting and form emergence, which exemplify the different emphases in research approaches. Typecasting theory focuses on well-established categories and considers the implications for individual producers of specializing in versus generalizing across categorical boundaries (Zuckerman, Kim, Ukanwa, and von Rittman 2003). Research suggests that audiences have an easier time making sense of specialists but that a clear association with a single category restricts the range of future opportunities.

Form-emergence theory considers how the attributes of producers associated with an emerging category shapes its likelihood of gaining legitimacy among relevant audiences (McKendrick and Carroll 2001; McKendrick, Jaffee, Carroll, and Khessina 2003). Work in this area finds that a category is more likely to become a well-established form when new entrants have focused identities (as in the case of *de-novo* entrants, the producers who begin as members of the category).

These theory fragments have progressed largely independently of one another. This is not surprising given differences in levels of analysis and key outcomes. Yet, they are clearly conceptually connected. Both theory fragments address the positioning of producers in a space of categories and the effect of such positions on an audience's understandings. In this paper, we flesh out these connections to clarify the processes that lie at heart of theories of categorization. In particular, demonstrate that a common foundation, a theory of partiality in memberships, gives rise to predictions central to both of these fragments.

We use the formal theory-building tools and framework developed by Hannan, Pólos, and Carroll (2007) and extended by Pólos, Hannan, and Hsu (2008). These accounts developed modal constructions that allow for subtle formalization of key sociological concepts such as legitimation, identity, and social form, which revolve around the beliefs held by relevant audiences. As we aim to illustrate, this approach to theory building has value for producing coherent, integrative models of perceptions, defaults, and beliefs.

We begin with a brief overview of key concepts from recent theoretical work by Hannan et al. (2007) on category and form emergence. We extend this theory to develop a theorem that fits the typecasting imagery developed by Zuckerman and colleagues. Then, with a few additional considerations, we establish a formal proof of a foundation for McKendrick and Carroll's arguments regarding form emergence.

1 Modal Models for Legitimation

Hannan et al. (2007) highlight the role of the audience in constructing organizational categories and assigning membership to them. Their theory considers a domain as consisting of a dual role structure: producer (an agent who makes offerings in the domain) and audience member (an agent who evaluates offerings and potentially rewards producers of offerings that they find appealing) and a language.

The basic linguistic objects are labels that audience members apply to producers. Accordingly, we begin with a labeling function, which maps from triplets of audience members, producers, and time points to the powerset of the set of available labels.[1] We denote the set of labels that audience member y applies to producer x at time t as $\mathbf{l}(x, y, t)$. If the audience member applies the label l to x at time t, then $l \in \mathbf{l}(x, y, t)$.

Labels are often paired with schemas that tell what the label means to an audience member. A schema thus establishes the meaning (or intension) of a label.[2] It provides an abstract model or representations of the feature values that are consistent with a given label.

Formally, we represent schemas for labels as sets of formulas that pick out a set of relevant features (or relations). We distinguish the values of those features (or relations) that are consistent with membership in a label from those that are not.[3] Let $\mathbf{f}_i = \{f_1, f_2, \ldots f_i\}$ be the indexed set of i features that are relevant for a

[1]The powerset of a set is the collection of all of its subsets. We refer the powerset here because an audience member can apply multiple labels to the same object.

[2]In the tradition of logical semantics, intensions are functions that map possible worlds to extensions. Some readers might wonder if we depart from that tradition. We do not. Schemata tell what rules should the entities satisfy to be full-fledged members of a label. In different possible worlds different entities satisfy the schemata; but in any possible world it is given who satisfies them and to what extent. That is, schemata define the extensions of labels in all possible worlds so they define the intension of the label.

[3]The ordering of elements in a listing of the membership of a set is generally arbitrary. Here

schema. Each feature in the set has a range of possible values. We denote the set of possible values of feature f_j by $\mathbf{r}_j$ and a value for an object at a time point as $f_{j,x,t}$.

Definition 1 (Schema)**.** *A schema for a label maps pairs of audience members and time points to an n-tuple of nonempty subsets of values of the relevant features; this subset contains the schema-conforming feature values.* (HPC Def. 3.1)[4]

$$\sigma_l : \mathbf{a} \times \mathbf{t} \longrightarrow \mathscr{P}(\mathbf{r_1}) \times \cdots \times \mathscr{P}(\mathbf{r_I}); \quad \sigma_l(y,t) = \langle \mathbf{s}_1, \ldots, \mathbf{s}_I \rangle \equiv \mathbf{S}_I$$

where $\mathscr{P}(\cdot)$ denotes the powerset (set of all subsets of a set), $\mathbf{s}_i$ is the set of all the schema conforming values of the ith feature, and I is the total number of schema-relevant features. The schema $\sigma(l,y,t)$ is defined provided that $l \in \mathbf{l}(k,y,t)$.

A pair consisting of a label and a schema that tells its meaning is called a type. As we will elaborate on later, in some cases audience members take conformity to their schema for a label of those bearing the label as a natural fact, as taken for granted. A type for which taken-for-granted compliance is assumed is called a concept.

Definition 2 (Type)**.** *A type is a function that maps from pairs of audience members and time points to the powerset of the Cartesian product of the set of available labels and the set of available schemata.* (HPC Def. 3.2)

$$\mathbf{ty} : \mathbf{a} \times \mathbf{t} \longrightarrow \mathscr{P}(\mathbf{l} \times \mathbf{S}), \text{ such that } (\langle l, \mathbf{S}_I \rangle \in \mathbf{ty}(y,t)) \leftrightarrow (\sigma(l,y,t) = \mathbf{S}_I).$$

From the definition of a schema as a function, it follows that at most one schema can be paired with a label. Therefore, types for labels are unique.

Notation. At this point in the argument, we must introduce quantification. The theory on which we build states (some) definitions, postulates, auxiliary assumptions, lemmas, and theorems in a nonmonotonic logic (Pólos and Hannan 2002, 2004). In formal terms, models of arguments are given in terms of sequences of intensions of open formulas. It contains a formal language to represent causal stories and defines a new kind of quantifier, denoted by $\mathfrak{N}$. Formulas quantified by $\mathfrak{N}$ state what is expected to "normally" be the case according to a causal

we fix the ordering of elements by expressing the relevant sets of features and of their values as indexed sets. Suppose we have a set $\mathbf{x} = \{x_1, x_2, \ldots x_n\}$ and a set I containing the first i natural numbers: $\mathbf{i} = \{0, 1, 2, \ldots i\}$. We can express the indexed set $\mathbf{x}_n = \{x_i \mid i \in \mathbf{n}\}$.

[4]This notation refers to Definition 3.1 in Hannan, Pólos, and Carroll (2007).

story. The normal case is what we assume to be the case if we lack more specific information that overrules the default. The implications of a set of rules with exceptions, provisional theorems, are the logical consequences of a stage of a theory. Provisional theorems have a haphazard existence: what can be derived at one stage, might not be derivable in a later stage. So the status of a provisional theorem differs from that of a causal story. The syntax of the second language codes this difference. It introduces a "presumably" quantifier, denoted by $\mathfrak{P}$. Sentences (formulas) quantified by $\mathfrak{P}$ are provisional theorems at a stage of a theory if they follow from the premises at that stage.

Our arguments rely partly on auxiliary assumptions, which make certain analyses tractable. Because auxiliary assumptions have a different status from causal claims that are believed to be true in the world, we mark them with a different quantifier, $\mathfrak{A}$ (for "assumedly"). Their role in inference is the same as for formula quantified with $\mathfrak{N}$.

Throughout this paper we assume that the reader is familiar with the distinction of free and bound variables, and we use this to establish the following conventions.

1. The out-most quantifier of the formula, that is the quantifier whose scope is the whole formula, binds all the free variables of the formula. This allows us to omit the (sometimes long) lists of variables following these quantifiers.

2. If the quantifier whose scope is the whole formula is *universal*, then we omit the quantifier as well, but we still indicate its scope with square brackets.

Types can have positive, neutral, or negative valuation. For issues related to typecasting, the interesting case concerns positive valuation. In such cases, greater fit with an audience member's schema yields greater intrinsic appeal, or fit with her tastes for offerings of that type. Let $\tilde{\alpha}(l, x, y, t)$ be a function that tells the intrinsic appeal of the offering of producer x in type l to audience member y at time point t.

Definition 3 (Positively valued type)**.**

$$[\textsc{pvt}(l, y, t) \leftrightarrow \exists \mathbf{S}_I [\langle l, \mathbf{S}_I \rangle \in \mathbf{ty}(y, t)] \\ \wedge \mathfrak{N}\, x, x', y[(\mu_i(x, y, t) > \mu_i(x', y, t)) \rightarrow \mathrm{E}\{\tilde{\alpha}(l, x, y, t)\} > \mathrm{E}\{\tilde{\alpha}(l, x', y, t)\}]].$$

Following several major lines of work in cognitive psychology and cognitive science, we assume that assessments of producers' membership can be partial, a matter of degree. Based on the configurations of features in a schema, an audience member regards producers with certain configurations as full-fledged members of a type (or category), others as having a moderate or low standing as a member, and still others as completely outside the type boundary. The degree to which the producer's characteristics fit a schema is reflected in a grade of membership (GoM) function. In particular, $\mu_{i(l)}(x, y, t)$ denotes the GoM of x in the audience member y's "meaning" (intension) of the label l at time t. (Hannan et al. (2007) equate the GoM in the meaning of a label to the GoM in the schema.)

1.1 Perception, Defaults, and Beliefs

An audience members' experience with type members shapes the strength of her schema for the type label. In some cases, an audience member may generally find type members to have a high GoM in the label—they display feature values that fit well the relevant schema. This generic fit and low frequency of observed misfits causes audience members to come to take for granted that the behavior and structures of any producers for which they apply the type label are completely consistent with the schema. Beliefs about schema conformity thus become default assumptions of everyday life. This means the defaults are used to fill in the many gaps in perceptions that come about from incomplete information, unobservability, and ambiguity.

We introduce three modal operators—perception, default, and belief—to analyze these issues. In logic, the term modality originally was used originally to refer to qualities of the truth of an expression, especially the possibility and necessity of a statement. The technical apparatus for analyzing logics with operators for possibility and necessity has been generalized to treat statements about an agent's attitude toward an object or relation; and the term modality is now generally extended to include expressions of perceptions, beliefs, and valuations. We use this extended sense of modality.

We refer to an agent's information state about a factual situation as a set of beliefs. Perceptions contribute to beliefs in an immediate way; what agents directly perceive updates the set of beliefs that they hold. Thus, the temporal order of perceptions matters: more recent perceptions replace older ones in case they conflict. But agents' perceptions are generally partial, making some propositions true and others false, while leaving open the truth/falsity of others. As such partiality generates uncertainty, it is natural that mechanisms emerge that eliminate some of the gaps. Agents rely on defaults to "fill in" missing facts when the value of a relevant fact direct perception is lacking *and* an applicable default is available. That is, defaults shape beliefs only in the absence of current perception of the facts in question. And although beliefs based on taken-for-granted assumptions shape information states (and thus behavior), such defaults are exposed to revision due to direct perceptions that conflict with the assumed facts.

In our substantive context, the audience members pay attention to the values of certain features of producers (or products) in a market. Our formal language contains atomic formulas of the form: $f(x,t) = v$, where f refers a feature, x to a product or producer, t to a time point, and v is a value of f.

To formally describe the interrelations of the three belief attitudes, we introduce three new logical constants. These are defined for an (arbitrary) audience member y and sentence (or formula) ϕ. We extend the standard "box" notation for the necessity operator to denote these new logical constants:

$\boxed{\text{P}}_y\,\phi$ stands for "The agent y perceives that ϕ is the case."

$\boxed{\text{D}}_y\,\phi$ stands for "The agent y takes for granted that ϕ is the case (in the absence of contrary perception)."

$\boxed{\text{B}}_y\,\phi$ stands for "The agent y believes that ϕ is the case."

Pólos et al. (2008) defined a model for the language containing these operators and provided their formal semantics. Their model was designed to satisfy the following constraints:

1. perception is partial at all time points;
2. beliefs must be grounded in either perception or taken-for-granted assumptions;
3. as seeing is believing, perception (at least temporarily) overrides earlier beliefs;
4. defaults shape beliefs (unless there is perceptual evidence to the contrary);
5. lasting beliefs develop if lasting taken-for granted assumptions are not contradicted by perceptual evidence.

As we noted above, the temporal structure of the belief attitudes matters. It is helpful in dealing with this issue to use the following notation.

Notation. Let $\phi(x,t)$ be a formula, x an object, and t a temporal parameter. (In our substantive application x denotes a producer and ϕ denotes one of its feature values at the time point t.) In the case of the belief modality,

$$\exists\, t'\, \forall\, t''\, [(t' \leq t'' < t) \rightarrow \boxed{\text{B}}_y\,\phi(x,t'')] \text{ will be abbreviated as } \overleftarrow{\boxed{\text{B}}_y}\,\phi(x,t);$$

$$\exists\, t'\, \forall\, t''\, [(t < t'' \leq t') \rightarrow \boxed{\text{B}}_y\,\phi(x,t'')] \text{ will be abbreviated as } \overrightarrow{\boxed{\text{B}}_y}\,\phi(x,t).$$

The notation is exactly parallel for the other two modalities.

1.2 Defaults and Induction

Audience member's perceptions of a producer's fit to schemas for a label are often partial. In some cases, an audience member sees (or treats as a default) only that a producer claims a label or that some other audience members (perhaps critics or another kind of gatekeepers) apply the label to the producer. Such situations offer the analytic leverage needed to define legitimation. The key issue is how many schema-consistent features an audience member needs to check (in terms of beliefs) before she assumes conformity with the schema for the unchecked features.

This idea can be represented in terms of a *test code,* a partial segment of a schema that an audience member uses to make inferences about fit to the rest of the schema on which she has no beliefs (perceptions or defaults). If the audience member believes that a producer "passes" the test, then she induces that the unperceived/non-default values of schema-relevant features also fit the schema. In technical terms, (believed) satisfaction of a test triggers the audience member to apply the default that the unperceived/non-default feature values also satisfy the schema.

We first formalize the idea of a test for fit with a schema. It is helpful to introduce some notation for this task. Let $\mathbf{S}_I$ denote an indexed set of values of I features and $\mathbf{F}_J$ denote an indexed set of values of some subset of the relevant features: $0 \leq J < I$. We use the expression $f_{i,x,t} \in \mathbf{s}_i$ to represent the fact that the ith feature of the object x has a value that complies with the schema $\sigma(l,x,t)$ at the time point t.

We modify the definition of induction offered by Hannan et al. (2007, Def. 4.1), which holds that induction "fills in" all non-perceived feature values when a test is *perceived* to be satisfied. This overlooks the role of existing defaults. Recall that defaults are beliefs when there is no contrary perception. There does not appear to be any reason to think that audience members will override existing defaults based only the passing of a test on other features. So we refine the earlier conception in line with this intuition. That is, we propose that induction works on features about which the audience member has no belief (based either on perception or default).

Definition 4 (Induction from a test)**.** *An induction from a test is a situation in which an audience member's perception that a producer bears a type label and that its feature values satisfy a test triggers the audience member to apply the default that the values of features about which there is no prior belief to the contrary also satisfy the schema.*

Let $\sigma(l,y,t) = \mathbf{S}_I$.

$$[\text{INDUC}(\sigma(l,y,t),\mathbf{t}_J) \leftrightarrow \forall i,j,x[(l \in \mathbf{l}(x,y,t)) \wedge (j \in J) \wedge (i \in I \setminus J) \\ \wedge (\boxed{\text{B}}_y (f_{j,x,t} \in \mathbf{t}_j)) \rightarrow (\neg \boxed{\text{B}}_y (f_{i,x,t} \not\in \mathbf{s}_i)) \leftrightarrow \overrightarrow{\boxed{\text{D}}}_y (f_{i,x,t} \in \mathbf{s}_i)]].$$

In that case, we refer to $\mathbf{t}_J = \{\mathbf{t}_j \mid j \in J\}$ *as* y*'s* test *for judging conformity to the schema* $\sigma(l,y,t)$*, in notation,* $\text{TST}(\sigma(l,y,t),\mathbf{t}_J)$*, and we say that the test has* J *items.*

If an audience member must check every relevant feature before assuming as a default that the rest of a producer's features match the relevant schema, then nothing is taken for granted. If only a small fraction of the relevant features must be checked (perhaps only a claim to the label), then defaults get used in a powerful way. These comparisons make the most sense when we consider the *minimal* test for an audience member-schema pair, the test that involves the smallest number of features.

Definition 5 (Minimal test for induction)**.** *The set of values of the* J *features,* $\mathbf{t}_J$*, is* y*'s minimal test for induction for the schema for* l *at time* t*, in notation* $\text{MT}(\sigma(l,y,t),\mathbf{t}_J)$*, iff (1) it is one of* y*'s tests for conformity with the schema; (2) it no more test features for the schema than any other of* y*'s tests; and (3)* y *induces satisfaction of the schema* $\sigma(l,y,t)$ *on the untested features from this test.* (HPC Def. 4.2)

The relative size of the minimal test for induction for fit to a schema for a label relates directly to the degree of taken-for-grantedness of the label for the audience member.

Definition 6 (Taken for grantedness)**.** *The degree to which an audience member takes for granted that the untested feature values of a labeled producer conform to a schema for the label at a time point is the ratio of the size of the untested portion of the schema to size of the whole schema.* (HPC Def. 4.2)

$$[g(l,x,y,t) \equiv \begin{cases} (I-J)/I & \text{if } (\langle l, \sigma(l,y,t) = \mathbf{S}_I\rangle \in \text{TY}(y,t)) \wedge \text{MT}(\sigma(l,y,t),\mathbf{t}_J) \\ & \quad \wedge (l \in \mathbf{l}(x,y,t)); \\ 0 & \text{otherwise}]. \end{cases}$$

An audience member's taken for grantedness of a label at the time point is given by simple average of g *over the producers to which she applies the label:*

$$[G(l,y,t) \equiv \textstyle\sum_{x \mid l \in \mathbf{l}(x,y,t)} \dfrac{g(l,x,y,t)}{|\{x \mid l \in \mathbf{l}(x,y,t)\}|}].$$

Note that I indicates the (crisp) cardinality of the set of schema-relevant features and J indicates the cardinality of the minimal test. Therefore, this definition sets $g = 0$ if the audience member does not apply the label to the object or needs to see every (nonlabel) feature before making an induction (which is no induction at all); nothing is taken as satisfied by default. It sets $g = 1$ if applying the label by itself shifts the audience member to defaults about schema-conformity on all other relevant features. In this case, the test on feature values is empty, $J = 0$; and the test is passed automatically whenever the label is applied.

A highly taken-for-granted type is referred to as a concept.

Definition 7 (Concept)**.** *An audience-segment member's type is a concept if the member treats conformity to her schemata for the type label as taken-for-granted for all those producers/products to which she assigns the label.* (HPC Def. 4.5)

$$[\text{CONCEPT}(l, y, t) \leftrightarrow (\langle l, \sigma(l, y, t)\rangle \in \mathbf{ty}(y, t)) \wedge (G(l, y, t) > \mathfrak{g} \approx 1)].$$

2 Incomplete Beliefs and Defaults in Typecasting

Clearly, reliance on defaults about concept membership shapes how audience members regard the producers to whom they apply a label. We claim that defaults also play a key role in creating the typecasting dynamic that Zuckerman et al. (2003) highlight in their study of the careers of Hollywood film actors. This research finds that actors who are strongly identified with a single type (genre) of work often find it difficult to obtain future work in other types difficult. Presumably, audience members assume that each type of work requires a distinct set of skills, so clear identification with one type of work implies that an actor lacks the skills necessary for others.

Our understanding of typecasting is that it depends on partiality of available information. Sometimes audience members have full information about the properties of some producer and can tell whether it fits one or another schema. In such situations, there is no reliance on typecasting—the agent relies on direct perception. But, when perception is incomplete, knowledge that a producer fits one type generally gets treated as evidence that it likely does not fit other types (with clashing schemas).

More generally, the typecasting dynamic suggests that the belief that a producer is a member of one type will (1) increase the producer's appeal in exchanges of that type and (2) prevent acceptance of its membership in others. To build to that multiple-type case, we first need to consider how taken-for-grantedness affects the assignment of GoMs in cases in which test codes are satisfied but the audience member does not have a belief about schema satisfaction for some relevant features. In doing so, we contrast the role of concepts and mere types.

To simplify our formal story, we construct our arguments at the audience-member level. These results can be aggregated member by member to derive implications for an audience. In the interest of brevity, we do not develop these aggregate implications formally.

We treat simple situations in which fit to a schema can be assessed by simply counting matches and mismatches of features to the schema. (In more complex cases, there might be weights assigned to features such that mismatches reduce fit more when they occur on certain features or elements of schemas might be conditional, meaning that the value of one feature affects what is schema-conforming on another). We implement this restriction with the notion of a flat schema.

Definition 8 (Flat schema)**.** *An audience member's schema for a label is flat if and only if an audience member normally assigns higher grades of membership to objects with more matches to the schema and fewer mismatches.*

Let $\sigma(l,y,t) = \mathbf{S}_I$ and let $p^{+}(l,x,y,t)$ denote the proportion of features values of x on which y's beliefs at t are schema conforming, i.e.,

$$[p^{+}(l,x,y,t) = \frac{|\{f \mid \boxed{\mathrm{B}}_y\, f_{i,x,t} \in \mathbf{s}_i\}|}{|\{f \mid \boxed{\mathrm{B}}_y\, f_{i,x,t} \in \mathbf{s}_i\}| + |\{f \mid \boxed{\mathrm{B}}_y\, f_{i,x,t} \notin \mathbf{s}_i\}|}].$$

$$[\mathrm{FLAT}(l,y,t) \leftrightarrow \mathfrak{N}\, x,x'\, [(p^{+}(l,x,y,t) > p^{+}(l,x',y,t)) \rightarrow \mathrm{E}\{\mu_{i(l)}(x,y,t)\} > \mathrm{E}\{\mu_{i(l)}(x',y,t)\}].$$

How can we represent the idea that audience members often lack complete beliefs about schema satisfaction? Because we want to make the argument general and we do not have any prior expectations about patterns, we develop a simple baseline probability model that allows us to compare situations that are alike on average. (We state the elements of the probability model as auxiliary postulates, which means that they are stated as analytical conveniences not as claims about the world.)

The first step defines a common probability over schema-relevant features that an audience member lacks a belief. Our baseline model holds that the schema-relevant features do not differ in the probability that an audience member lacks a belief about conformity to the schema. In other words, each audience member has available beliefs on a random sample of schema-relevant features.

Auxiliary assumption 1 (Beliefs about random samples of features)**.** *Beliefs about fit to a schema for a label are available at random for an audience member–producer pair in the sense that the probability that the audience member does not have a belief about the value of a feature is the same for all schema-relevant features.*

Let $\sigma(l, y, t) = \mathbf{S}_I$.

$$\mathfrak{A}\,[\exists \pi \forall i[(i \in I) \rightarrow \Pr\{\neg \exists v\,[\boxed{\text{B}}_y\,(f_{i,x,t} = v)]\} = \pi]]].$$

The key intuition behind typecasting relies on a counterfactual: had the audience member had full information about two producers (who differ in their histories of prior labels and memberships), she would have no reason to prefer one to the other. According to the counterfactual, the audience member would regard the producers as having equal grade of membership in terms of satisfaction of her schema. To represent this notion, we assume as the second element in the baseline probability model that the two producers being compared are equally likely to satisfy the audience member's schema if the audience member had a positive belief about their values. We do so by assuming that the probability that a belief that an arbitrary feature conforms to the schema is the same for the two producers being compared. In other words, the producers are equivalent in expected-value terms.

Auxiliary assumption 2 (Common probability of schema-conforming beliefs)**.** *The probability that an audience member believes that one of a producer's feature values satisfies here schema for a label (conditional on a belief) is the same for all audience-member–producer pairs.*

Let $\sigma(l, y, t) = \mathbf{S}_I$.

$$\mathfrak{A}\,[\exists \rho \,\forall i[(i \in I) \rightarrow \Pr\{\boxed{\text{B}}_y\,(f_{i,x,t} \in \mathbf{s}_i) \mid \exists v[\boxed{\text{B}}_y\,(f_{i,x,t} = v)\}] = \rho]].$$

We can now verify that this probability model, when applied to flat schemas, implies a pattern that agrees with the core intuition about the constraints imposed by typecasting. We develop this implication for a simplified situation which makes the analysis tractable. The simplification considers situations in which the audience members have flat schemas for two labels, l and l', of the same length ($I = I'$),[5] has minimal test codes for each schema, and the probabilities that the audience member has a belief about a l-schema-relevant feature

[5]If we allow I, I', J, and J' to vary freely subject only to the constraint that $(I - J)/I > (I' - J')/I'$ (the relevant condition for judging the degree of taken for grantedness), the implications appear to be indeterminate.

and that beliefs indicate schema conformity are equal for the two triplets of producers, audience members, and time points.

Let $\Phi[t, t'] \leftrightarrow$

1. l is a concept for the members of the audience over the interval $[t, t']$ and their schemas for it do not change over the interval:

$$[(t \leq s \leq s' \leq t') \rightarrow \exists \mathbf{S}_{I(l,y)} [(\langle l, \mathbf{S}_{I(l)}(y, s)\rangle \in \mathbf{ty}(y, s)) \\ \wedge (\mathbf{S}_I(l, y)(y, s) = \mathbf{S}_{I(l)}(y, s'))]];$$

2. l' is a type for the audience members at (at least) the end point of the interval:

$$[\exists \mathbf{S}_{I(l',y)} [\langle l', \mathbf{S}_{I(l',y)}(l', y, t')\rangle \in \mathbf{ty}(y, t')]];$$

3. the audience members' schemas for l and l' are flat over the interval:

$$[(t \leq s \leq t') \rightarrow \text{FLAT}(l, y, s) \wedge \text{FLAT}(l', y, s)];$$

4. on average, beliefs about the l-relevant and l'-relevant feature values of all the producers in the domain are incomplete to the same degree for all audience members over the time interval and all producers fit the audience member's schemas for l to the same degree within that interval. In formal terms, this means that within the period $[t, t']$ neither π nor ρ depends on the label, the time, the producer or the audience member.

Lemma 1. *Under random availability of beliefs for flat schemas with a common probability of forming a schema-conforming belief, audience members presumably assign higher grades of memberships (to producers) in the meaning of a label when the conformity with label is more taken for granted.*

$$\mathfrak{P}[\Phi[t, t'] \wedge (I(l, y) = I(l', y')) \wedge (g(l, x, y, t) > g(l, x', y', t')) \\ \rightarrow \text{E}\{\mu_{i(l)}(x, y, t)\} > \text{E}\{\mu_{i(l)}(x', y', t')\}].$$

[The proof of this lemma, along with those of other lemmas and theorems, can be found in the Appendix.]

According to Lemma 1, an audience member presumably assigns a higher grade of membership to a producer when her minimal test for induction is smaller and thus conformity with the schema is more taken for granted. This result has an immediate implication about the importance of concepts in situations of partial beliefs.

Theorem 1. *When audience members have partial observations on some type-relevant producer characteristics, they presumably assign higher grades of membership in the type to objects when the type is a concept (that is, highly taken for granted).*

$$\mathfrak{P}\,[\Phi[s,s'] \wedge \Phi[t,t'] \wedge (I(l,y) = I(l',y')) \wedge \textsc{concept}(l,y,t) \wedge \neg\textsc{concept}(l',y',t') \\ \rightarrow \mathrm{E}\{\mu_{i(l)}(x,y,t)\} > \mathrm{E}\{\mu_{i(l')}(x',y',t')\}].$$

Because we focus on positively valued types, the argument behind Theorem 1 also implies a parallel difference in the intrinsic appeal of offerings for concepts versus mere types.

Corollary 1. *When audience members have partial observations on some type-relevant producer characteristics, they presumably find the offerings of members of the type more appealing when the type is a concept (highly taken-for-granted).*

Let the conditions stated in the preamble to the foregoing theorem hold and let $\textsc{pvt}(l,y,t) \wedge \textsc{pvt}(l',y',t')$.

$$\mathfrak{P}\,[\Phi[t,t'] \wedge (I(l,y) = I(l',y')) \wedge \textsc{concept}(l,y,t) \wedge \neg\textsc{concept}(l',y',t') \\ \rightarrow \mathrm{E}\{\tilde{\alpha}(l,x,y,t)\} > \mathrm{E}\{\tilde{\alpha}(l',x',y',t')\}].$$

3 Typecasting

The argument made to this point, together with the behavior of the modalities, yields what we regard as a somewhat surprising implication. Consider the case in which an audience member first decides that a producer passes the minimal test code for a concept and does not display any observable violations of the schema for that concept. She then later finds that the same producer also passes the minimal test code for a clashing concept and does not display any observable violations of the schemata for that concept. What happens?

To provide a formal answer to this question, we first define clashes between schemas.[6] To simplify what follows, we define pairs of labels whose schemas clash (for an audience member) but only outside of their minimal test codes.

[6] Hannan et al. (2007) define schema clash indirectly with a meaning postulate (MP5.1) that presumes part of what we want to derive: "Normally, the higher a producer's grade of membership in a type whose schema clashes with that of a focal category, the lower the producer's grade of membership in the focal type."

Definition 9. *An audience member's schemas for a pair of labels clash outside the minimal test codes.*

Let the set of features on which the schemas l and l' clash for the audience member and time point be denoted by $\mathbf{cl}^+(l,l',y,t)$, that is,

$$[\mathbf{cl}^+(l,l',y,t) = \{f_i \mid \forall t,x[(f_i \in \mathbf{S}_I \cap \mathbf{S}_{I'}) \to \neg((f_{i,x,t} \in \mathbf{s}_i) \leftrightarrow (f_{i,x,t} \in \mathbf{S}_{i'}))]\}];$$

and let the set of features on which they do not clash be denoted by $\mathbf{cl}^-(l,l',y,t)$, that is,

$$[\mathbf{cl}^-(l,l',y,t) = \{f_i \mid \forall t,x[(f_i \in \mathbf{S}_I \cap \mathbf{S}_{I'}) \to (f_{i,x,t} \in \mathbf{s}_i) \leftrightarrow (f_{i,x,t} \in \mathbf{S}_{i'})]\}].$$

Finally, let

$$[(\langle l,\mathbf{S}_I(t)\rangle \in \mathbf{ty}(y,t)) \wedge (\langle l',\mathbf{S}_{I'} \in \mathbf{ty}(y,t)) \wedge \text{MT}(\sigma(l,y,t),\mathbf{t}_J) \wedge \text{MT}(\sigma(l',y,t),\mathbf{t}_{J'})].$$

Then schema clash outside minimal test codes is defined as follows:

$$[\text{CLASH}(l,l',y,t) \leftrightarrow \forall j[(j \in J \cap J') \to (j \notin \mathbf{cl}^+(l,l',y,t))] \wedge (\mathbf{cl}^+(l,l',y,t) \neq \emptyset)].$$

As we thought about these issues, we first reasoned that a schema clash might block an audience member from applying defaults and would yield a lowered GoM in both concepts. But we recognized that the default modality does not work in this way. Once defaults are set, they have the status of facts (unless and until they are overridden by new perceptions). So, in the scenarios we are considering, the audience member treats all of the schema-relevant features as satisfying the schema and also treats the default-facts as facts when considering membership in the clashing concept. The result is that the audience member decides that the producer does not fit well the focal (clashing) concept, and she does not alter her judgment of the producer's typicality in the original concept. This conclusion fits the typecasting imagery.

We now develop this argument formally, building on the argument behind Theorem 1. The key step in linking this argument to typecasting is constructing meaningful simplifying assumptions that allow us to capture the key insights.

Let $\Psi[t,t'] \leftrightarrow$

1. the schemas for l and l' clash outside the minimal test codes and schema clashes outnumber non-clashes from the perspective of all of the audience members:

$$[\text{CLASH}(l,l',y,t') \wedge (0 < |\mathbf{cl}^+(l,l',y,t')| > |\mathbf{cl}^-(l,l',y,t')|)];$$

2. each audience member applies the label l to the producer x and believes that the producer x passes her minimal test code for l over the relevant time interval:

$$[(t \le s \le t') \to (l \in \mathbf{l}(x,y,s)) \\ \wedge \exists \mathbf{s}_j \forall j [\text{MTST}(l,y,s,\mathbf{t}_J) \wedge (j \in J) \to \boxed{\text{B}}_y (f_{j,x,s} \in \mathbf{s}_j)]];$$

3. each audience member either does not apply the label l to the producer x' or does not believe that the x' passes her minimal test code for l over the relevant time interval:

$$[(t \le s \le t') \to (l \notin \mathbf{l}(x',y,s)) \vee (\exists j [(j \in J) \to \boxed{\text{B}}_y (f_{j,x',s} \notin \mathbf{s}_j)])];$$

4. each audience member applies the label l' to both producers at the later time point t': $l' \in \mathbf{l}(x,y,t') \cap \mathbf{l}(x',y,t')$.

Theorem 2 (Typecasting)**.** *In the case of two concepts with schemas that clash only outside audience members' minimal tests for them, membership in one concept at an earlier point in time presumably (1) yields a higher fit to that schema at subsequent times but (2) reduces the fit to the other schema at a later point in time (when the audience members do not generally have beliefs about a producer's conformity to schema on all relevant features).*

$$\mathfrak{P}[\Phi[t,t'] \wedge \Psi[t,t'] \wedge (t' > t) \to \text{E}\{\mu_{i(l)}(x,y,t')\} > \text{E}\{\mu_{i(l)}(x',y',t')\} \\ \wedge \text{E}\{\mu_{i(l')}(x,y,t')\} < \text{E}\{\mu_{i(l')}(x',y',t')\}].$$

In the case of positively valued types, the following corollary immediately follows.

Corollary 2. *In the case of two concepts with schemas that clash only outside audience members' tests for them, membership in one at an earlier point in time presumably (1) enhances the intrinsic appeal of the producer's offering in the first concept but (2) reduces the appeal of its offering in the other at a later point in time when the audience members do not generally have beliefs about a producer's conformity to schema on all relevant features.*

$$\mathfrak{P}[\Phi[t,t'] \wedge \Psi[t,t'] \wedge (t' > t) \wedge \text{PVT}(l,y,t) \wedge \text{PVT}(l',y,t') \\ \to \text{E}\{\tilde{\alpha}(l,x,y,t')\} > \text{E}\{\tilde{\alpha}(l,x',y',t')\} \wedge \text{E}\{\tilde{\alpha}(l',x,y,t')\} < \text{E}\{\tilde{\alpha}(l',x',y',t')\}].$$

Theorem 2 and Corollary 2 highlight both the benefits and the drawbacks of passing the minimal test code of a highly taken for granted type. On the one hand, reliance on defaults means that audience members for that type will assign a high grade of membership to the producer and find its offerings to have high intrinsic appeal. But this restricts the producer's ability to demonstrate fit with a clashing type in the future. Audience members will rely on prior defaults in the case of partial perception and immediately assume a poor fit with the schema and their tastes for offerings of the clashing type.

4 Contrast, and Taken for Grantedness

Our rendering of the typecasting argument has potentially broad implications. Exploring them requires attention to related processes underlying taken for grantedness (legitimation).

The original theory of density-dependent legitimation held that growth in the number of producers associated with a category increases its taken for granted status (Hannan and Freeman 1989). This basic formulation, however, did not address the idea that different producers may contribute differentially to the taken for grantedness of a category. To incorporate this notion and generalize the theory, Hannan et al. (2007) shifted attention from density to population contrast. Their argument operates at the audience level, and it holds that a category's taken-for-granted status increases with the (average) contrast—the degree to which membership in the meaning of the category approximates a binary distinction (full membership versus non-membership). Categories with high contrast stand out sharply against the background, increasing the likelihood that audience members see the cluster of producers in similar ways, which ease the rise of consensus among audience members about the meaning of the category label (intensional consensus). Their key postulate states that the level of legitimation of a label in the audience as a whole increases monotonically with the level of intensional consensus about the label.

Here we focus on another path, one that links legitimation to contrast at the audience member level.

Definition 10 (Type contrast)**.** *The contrast of a type for an audience member is the average of the nonzero grades of membership that the audience member assigns to the objects to which he assigns the type label.* (HPC Def. 3.4)

$$[c(l,y,t) \equiv \frac{\text{card}\{\mu_{i(l)}(y,t)\}}{|\text{supp}\{\mu_{i(l)}(y,t)\}|}],$$

where $\text{supp}\{\mu_{i(l)}(y,t)\} \neq \emptyset$; and it is undefined otherwise. $\text{supp}\{\mu_{i(l)}(y,t)\}$ refers to the support of a fuzzy set, in this case the crisp set of the producers to whom the audience member assigns nonzero GoM in the meaning of the label.

For an individual audience member, high type contrast means that the producers to whom the audience member assigns the type label generally fit the concept schema well (because high contrast means that the audience member assigns either high or very low GoM in the meaning of the label to the objects in the domain). Cases of poor fit to schemas will generally be viewed as exceptions to the general rule. Such generic fit causes the audience member to come to take for granted that any producers to which she applies the type label will have schema-consistent features. The probability that beliefs about schema conformity will become defaults thus increases with contrast.

Postulate 1. *A type's expected taken-for-grantedness for an audience member normally increases (with some delay) monotonically with its contrast.*

$$\mathfrak{N}\,[\exists u \forall s[(0 < s < u) \wedge (c_{i(l)}(y, t+s) > c_{i(l')}(y, t'+s)) \\ \wedge (G(l, t, t+s) = G(l', y, t'+s)) \rightarrow \mathrm{E}\{G(l, t, t+u) > \mathrm{E}\{G(l', y, t'+u)\}]].$$

With these notions in hand, we return to our main substantive focus, the effects of typecasting.

5 De-Novo and De-Alio Entrants

The intuition underlying our rendition of the typecasting theorem—that assumptions regarding a producerŠs membership in one concept constrain beliefs about fit with others—can be usefully extended to shed light on other aspects of the dynamics of types and concepts. In this section, we demonstrate this by considering how this process of induction and typecasting relates to key findings on form emergence. We continue here to build the model at the level of the audience member.

In their seminal study of the disk-array producers, McKendrick and Carroll (2001) found that a label for an emerging category gains more legitimation from *de-novo* entrants (those with no prior history) than from *de-alio* entrants (already existing producers who are diversifying). They reasoned that audience members perceive de-novo entrants as more focused on the activities associated with the label than their diversified counterparts and thus contribute more to audience members' understandings of what it means to be a type member. This finding had a serious impact on the thinking of organizational theorists. However, so far it has not been integrated into the formal theoretical framework of categories.

To capture McKendrick and Carroll's core insight, we focus on the case of de-alio entrants with clashing memberships. Just as the typecasting dynamic rested on the assumption that distinct genres correspond to distinct skill sets, the story about de-novo and de-alio entrants rests on the notion that the different producer types are associated with *clashing* schemas.

Definition 11 (De-novo and de-alio entrants)**.**

A. *A producer has de-novo status in a label to an audience member iff the audience member applies the label at the time point and has not previously applied any label to it.*

$$[\textsc{de-novo}(l, x, y, t) \leftrightarrow (l \in \mathbf{l}(x, y, t)) \wedge \forall t' [(t' < t) \rightarrow (\mathbf{l}(x, y, t) = \emptyset)]];$$

and the number of de-novo entrants over a time interval (from an audience member's perspective) is given by

$$e_n(l, y, t, t') = |\{x \mid (t \leq u < t') \wedge \textsc{de-novo}(l, x, y, u)\}|.$$

B. *A producer has de-alio-clashing membership in a label (from the perspective of an audience member) if the audience member applies the label at the time point and also continues to apply a label assigned earlier in a clashing concept and believes that the producer passes the minimal test for the clashing concept.*

$$\begin{aligned}[\textsc{de-alio}(l, x, y, t) \leftrightarrow (l \in \mathbf{l}(x, y, t)) \wedge \forall s[(s < t) \rightarrow (l \notin \mathbf{l}(x, y, s))] \\ \wedge \exists l', t' [\textsc{clash}(l, S_I, l', S_{I'}, y, t) \wedge \textsc{concept}(l', y, t) \wedge (I = I') \\ \wedge \textsc{mtst}(\sigma(l', y, t), \mathbf{t}_{J'}) \wedge \forall s[(t' \leq s < t) \rightarrow (l' \in \mathbf{l}(x, y, s)) \wedge \\ \forall j[(j \in J') \rightarrow \boxed{\text{B}}_y (f_{j,x,t} \in \mathbf{t}_{j'})]]]];\end{aligned}$$

and the number of de-alio-clashing entrants over a time interval (from an audience member's perspective) is given by

$$e_a(l, y, t, t') = |\{x \mid (t \leq s \leq t') \wedge \textsc{de-alio}(l, x, y, s)\}|.$$

When an audience member assesses the fit of a de-alio entrant from a clashing concept to a focal type, the process of induction that drives the typecasting dynamic (as stated in Theorem 2) is also at work. Membership in the clashing concept reduces fit of the de-alio entrant in the focal type. This puts the de-alio entrant at a disadvantage as compared with a comparable de-novo entrant (i.e., in the case where there is random availability of beliefs and a common probability of forming a schema-conforming belief for each producer).

Theorem 3. *De-novo entrants presumably have higher expected grades of membership in audience members' types than do de-alio entrants (with memberships in clashing concepts).*

$$\mathfrak{P}\,[\Phi[t,t'] \wedge \Psi[t,t'] \wedge \textsc{de-novo}\,(l,x,y,t) \wedge \textsc{de-alio}\,(l,x',y',t') \\ \rightarrow \mathrm{E}\{\mu_{i(l)}(x,y,t')\} > \mathrm{E}\{\mu_{i(l)}(x',y',t')\}].$$

This grade of membership disadvantage for de-alio entrants also results in a disadvantage in terms of the appeal of their offerings to audience members.

Corollary 3. *The offerings of de-novo entrants presumably have higher intrinsic appeal than do those of de-alio entrants (with memberships in clashing concepts).*

$$\mathfrak{P}\,[\Phi[t,t'] \wedge \Psi[t,t'] \wedge \textsc{de-novo}\,(l,x,y,t) \wedge \textsc{de-alio}\,(l,x',y',t') \\ \rightarrow \mathrm{E}\{\tilde{\alpha}(l,x,y,t')\} > \mathrm{E}\{\tilde{\alpha}(l,x',y',t')\}].$$

McKendrick and Carroll (2001) suggest that the extent to which audience members perceive a set of entrants as having a type focus contributes to the taken for grantedness of the type. This idea of perceptual focus can be analyzed in terms of contrast, as defined in the previous section. Because de-novo entrants have a higher expected grade of membership in an audience member's concept, they naturally contribute more to type contrast.

Lemma 2. *De-novo entrants presumably contribute more (with some delay) to the contrast of audience member's type than de-alio entrants from clashing concepts.*

Let the number of entries in two labels be the same over the relevant period $e_n(l,y,t,t') + e_a(l,y,t,t') = e_n(l',y',t,t') + e_a(l',y',t,t')$.

$$\mathfrak{P}\,[\Phi[t,t'] \wedge \Psi[t,t'] \wedge (e_n(l,y,t,t') > e_n(l',y',t,t')) \wedge (c(l,y,t) \geq c(l',y',t)) \\ \rightarrow \mathrm{E}\{c(l,y,t')\} > \mathrm{E}\{c(l',y',t')\}].$$

The core insight of the de-novo/de-alio story is an implication of the preceding argument. The implication follows from the foregoing lemma and Postulate 1. Because Lemma 2 yields a difference in the expected contrasts at the end of the period $[t,t']$ and Postulate 1 states a delayed effect of contrast on expected taken for grantedness, we express the desired theorem as holding for expected taken for grantedness at some time at or after t' (reflecting the possible delay in the effect of contrast on taken for grantedness).

Theorem 4 (McKendrick–Carroll)**.** *The expected (delayed) contribution of a set of entrants to the taken for grantedness of a type for an audience member presumably is higher for* de-novo *than* de-alio *entrants.*

Let the condition stated in the preamble to Lemma 2 hold.

$$\mathfrak{P}\,[\Phi[t,t'] \wedge \Psi[t,t'] \wedge (e_n(l,y,t,t') > e_n(l',y',t,t')) \wedge (c(l,y,t) \geq c(l',y',t)) \\ \rightarrow \exists u[(u \geq t') \wedge (\mathrm{E}\{G(l,y,u)\} > \mathrm{E}\{G(l',y',u)\})]].$$

6 Discussion

In this paper, we showed that a model of how audience members apply labels and assess fits of producers to schema, once extended to multiple concepts, can explain the dynamics central to theory fragments of typecasting and form emergence. A core process driving both theories is induction of fit to schemas. Audience members often rely on defaults regarding schema-relevant features to define the concept memberships of producers. In the case of partial observation, this results in their assigning a higher grade of membership to producers for a concept versus a mere type. And in the case of multiple memberships, this leads audience members to assume a producer already affiliated with one concept to be a poor fit with concepts with clashing schemata.

Our formalization also suggests a similar process of induction drives the findings by McKendrick and Carroll (2001) on form emergence. De-alio entrants are generally believed to have worse fit with a concept schema because they already belong to a clashing concept. Thus, de-alio entrants are assigned lower GoMs in a concept than their de-novo counterparts, and they contribute less to the taken for grantedness of a type.

We developed the model at the level of the audience member by considering the audience member's application of labels and assessment of fit to his/her own schemata for the label. As we noted above, these results have implications at the level of the audience as a whole. When the members of an audience come to substantial agreement about the meaning of a set of labels, they will generally make similar assessments of fit of producers to schemata and engage in induction based on similar observations. Hence, the line of argument we presented in this paper applies *mutatis mutandis* to a comparison of categories and forms, the audience-level parallels of types and concepts.

A core tool used to develop our findings is use of modal models. Following Hannan et al. (2007), we propose that audience members use defaults to fill in schema-relevant feature values for producers who pass their test for the concept. In the case of highly taken-for-granted types, this test code is very small and processes of induction are common. However, for less taken-for-granted types, a large test means the audience member will not assume much in terms of conformity with the concept schema. In such cases, the perception operator largely applies, and only partial membership will be assigned when an audience member lacks a belief about some schema-relevant features. Together, these modalities capture in a very specific way what seems distinctive about both membership in highly legitimated types and membership in multiple market types and concepts (categories and forms).

Proofs of Lemmas and Theorems

Testing what follows from the premises in a stage of a theory in the nonmonotonic logic we use operates on representations of arguments in the form of "rule chains." The links in these chains are strict rules, definitions, auxiliary assumptions, and causal stories. The chains start with the subject of the argument and terminate with the purported conclusion of the argument (the consequence to be derived). In nonmonotonic inference, different rule chains—each representing an argument embodied in the state of the theory—might lead to opposing conclusions. The testing procedure determines whether any inference can be drawn at all and, if so, which one. Such testing requires standards for assessing whether a pair of relevant rule chains is comparable in specificity and determining specificity differences for comparable chains. In the case of this paper, the available premises and definitions all point in the same direction; we do not see any rule chains that point to opposing conclusions. Thus all that is required is that we establish a rule chain that connects the antecedent and consequent in a claimed theorem.

Lemma 1.

Under the simplification stated in $\Phi(t)$ and the baseline probability model and the absence of induction, the expected ratio of beliefs that feature values fit the schemas for the two labels to positive beliefs about the relevant feature values are the same for the two situations being compared for any I and I' the expected ratio equals ρ. Given the restriction to a flat schemas, this implies that $\mathrm{E}\{\mu_{i(l)}(x,y,t)\} = \mathrm{E}\{\mu_{i(l')}(x',y',t')\}$ in the absence of induction. So the only systematic difference between these cases must be due to induction. In particular, if the expected number of inductions of schema satisfaction is greater for one situation than the other, then the expected grade of membership is higher for that situation.

Let the random variable that records the number of inductions be denoted by $in(l,x,y,t)$. By the law of total probability,

$$\begin{aligned}\mathrm{E}\{in(l,x,y,t)\} = \mathrm{E}\{in(l,x,y,t) \mid \text{min. test for } l \text{ passed}\}\cdot \Pr\{\text{min. test for } l \text{ passed}\}\\ + 0\cdot(1-\Pr\{\text{min. test for } l \text{ passed}\}),\end{aligned}$$

because no induction takes place if the minimal test is not passed. Under the baseline probability model stated in Auxiliary Assumptions 1 and 2, the probability that x passes y's minimal test for l equals $(\pi\rho)^J$.

Because inductions can only apply to features outside the test code (of which there are $I-J$ for the label l) for which the audience member does not have a belief about the value of the feature. The probability of not having a belief on a feature is $1-\pi$. So the expected number of inductions, conditional on passing the minimal test for l is $(I-J)(1-\pi)$. Thus $in(l,x,y,t)\} = (I-J)(1-\pi)\cdot(\pi\rho)^{J}$. Similar calculations yield $\mathrm{E}\{in(l',x',y',t')\} = (I'-J')(1-\pi)\cdot(\pi\rho)^{J'}$. The rule chain supporting the theorem requires that the expected number of inductions for l exceeds that for l', which requires that $(I-J)(1-\pi)\cdot(\pi\rho)^{J} > (I'-J')(1-\pi)\cdot(\pi\rho)^{J'}$. Dropping the common multiplier $(1-\pi)$ and setting $I = I'$, we check whether $(I-J)\kappa^{J} > (I-J')\kappa^{J'}$, where $\kappa = \pi\rho$. after rearranging terms, we must show that

$$\frac{I-J}{I-J'} > \kappa^{J'-J}.$$

By Definition 5, $g(l,x,y,t) > g(l',x',y',t')$ yields $(I-J)/I > (I'-J')/I'$ and the antecedent states that $I = I'$. Together these conditions imply that $J' > J$. This latter inequality in turn implies that $(I-J)/(I-J') > 1$ and $\kappa^{J'-J} < 1$ (because $\kappa = \pi\rho$ and the antecedent in the formula stating the lemma states that both π and ρ lie between zero and one). So the expected number of inductions is higher for l the type for which the producer x higher taken for grantedness in y's view, which implies that x's expected fit to y's meaning of l is higher than is the case for the other comparison.

Theorem 1.

The definition of a concept as a pair of label and schema for which an audience member has a very high level of taken-for-grantedness tells that the relative size of the minimal test for l is smaller than that for l'. With this inequality granted, the argument chain behind Lemma 1 applies.

Corollary 1.

The rule chain linking the antecedent and consequent results from application of the chain rule to the (rule chain supporting) Theorem 1 and the definition of a positively valued type (Definition 3).

Theorem 2.

In the absence of induction, the expected fit of both producers is the same for each label under the assumptions stated in the definition of $\Psi[t,t']$, because the audience member's schemas for the labels are flat and the probability that a schema-relevant feature will be observed is the same as is the probability that a positive belief will be one of schema conformity for each label. Induction can produce both increased fit (when the feature value induced fits the schema) and reduced fit (when the induction goes the other way).

In the case of the first term in the consequent (fit to l), the result follows from the assumption that the audience member believes that x passes the minimal test at all points in the interval and no information is available about such a belief for the second producer, x'. It then follows that induction will normally increase the fit to l for one producer (x) but not the other (x'). Under the assumption that clashes outnumber non-clashes, the expected net effect of induction is to reduce the fit of x to the second label (l') relative to that of x'.

Corollary 2.

The rule chain linking the antecedent and consequent results from application of the cut rule to the (rule chain supporting) Theorem 2 and the definition of a positively valued type (Definition 3).

Theorem 3.

According to Definition 10, a producer is a de-novo entrant in a label if the audience member applies the label at that time point and does not apply any label to the producer at any earlier time point. A producer is a de-alio-entrant (from a clashing concept) if the audience member applies the focal label to the producer and has earlier applied to it the label of a clashing concept. In such a comparison, the rule chain that supports Theorem 2 applies; and this rule chain yields the conclusion.

Corollary 3.

The rule chain that supports this implication relies on the application of the cut rule to the (rule chain behind) Theorem 3 and Definition 3.

Lemma 2

This is an immediate implication of Theorem 3, which tells that each de-novo entrant has higher expected GoM in the audience member's type than does a de-alio entrant. Definitions 11 and 12 tell that an entrant with higher GoM increases contrast more than does one with lower GoM, which implies that a de-novo entrant adds more to contrast. Addition over entries preserves this inequality, given the stipulation that the number of de-novo entries is at least as great as the number of de-alio entries.

Theorem 4.

This theorem follows from a cut rule applied to (the rule chain supporting) Lemma 2 and Postulate 1.

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