

4 Growing up: The development and acquisition of social knowledge

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Sociologists are generally concerned with understanding the interface between self and society. A variety of interface mechanisms have been suggested including, but not limited to, "role taking" and "role making" (Cicourel, 1974; Stryker, 1980; Smith-Lovin, this volume; Heise, 1987), development of shared meanings (Stryker, 1980; Burke, this volume; Smith-Lovin, this volume), development of common language (Cicourel, 1974; Shibutani, 1961; Luria, 1981; Callero, this volume), development of common response (Goffman, 1963; Heise, 1987; Smith-Lovin, this volume), and identity formulation (Stryker & Serpe, 1982; Serpe, 1987, this volume; Howard, this volume; Smith-Lovin, this volume; Blumstein, this volume; Burke, this volume; Stryker, this volume). Underlying all of these conceptions is the notion that what information¹ individuals have, and what information they share with others, is somehow key to the self-society interface. It is generally acknowledged that individuals do not acquire this information in a vacuum, but that the social context affects what information they acquire and what information they consider salient. For example, the extant social context impacts the individual's notion of self (Turner & Billings, this volume; Smith-Lovin, this volume; Stryker, this volume) and the individual's conception of others (Heise, 1987; Smith-Lovin, this volume). Two of the aspects of social context that have been explored include social structure and social knowledge. Social structure is often described in terms of the following: setting – for example, church; relative status and memberships – police officers, white, female; or opportunities for interaction – clubs one might join (Serpe, 1987; Schwalbe, this volume; Serpe, this volume; McPherson & Smith-Lovin, 1987); or the network of ties between individuals (White, Boorman, & Breiger, 1976; Burt, 1980; Granovetter, 1974; Carley, 1986a; for example). Social knowledge is often modeled as tacit shared knowledge (Smith-Lovin, this volume; Polanyi, 1962; Carley, 1986a, 1986b, in press-a).

In general, the extant social context is taken as a given, that is, a static

phenomena. Neither social structure nor social knowledge, however, is static. And as suggested by Howard (this volume), social change may be a product of individual change. Since the social context is generally treated as static, the dynamics of a society where what knowledge is social is continuously changing, where social structure is changing, where individuals are continually acquiring information and constructing their notion of self, have not been addressed in a systematic analytical fashion.

In this chapter, an analytic framework (referred to as constructivism) for exploring the relationship between self and society when neither the self nor the society is static is presented. The proposed model is based on the fundamental propositions that (a) interaction leads to shared knowledge and (b) relative shared knowledge leads to interaction. The utility of this model is demonstrated by looking at the question, Is it inevitable that parents and children have different views of the world?

People often speak of there being a generation gap. Evidence exists both anecdotally and in the literature that such gaps exist (Berkner, 1972; Netting, 1981; Caldwell, 1982). Further, such gaps are worse, that is, produce more tension and disagreement, as children get older and enter adulthood (Berkner, 1972; Netting, 1981). Explanations for such gaps include economic explanations (tension created by differentials in the means to control production), psychological explanations (desire for independence and tendency toward rebelliousness), cultural explanations (reverence of parents, age of marriage, etc.), and socialization explanations (difference in education). These explanations lead one to expect that if these differentials did not exist there would be no intergenerational gap and that this gap is peculiar to the process of becoming an adult. In this chapter it will be demonstrated that if individuals are not static, if they are continually learning, if they are continually engaged in the process of self-construction, then such gaps are inevitable. Further, it will be demonstrated that the degree to which such gaps occur is a function of structural factors, for example, the type of education provided and the level of *homogeneity* in the society.

Statements such as *I just don't understand my kids* and *Parents see things in a totally different way* suggest that the gap is a gap in not just age but in information. If growing up is a process of acquiring information, and parents and other caregivers are the ones imparting this information, then why is it that this gap exists? Part of the explanation surely lies in the fact that discoveries are made, and there is technological change. But even if there were not such systemic changes, would the gap still accrue? Further, do structural features of the society such as the relative scarcity or preponderance of children in the society affect the formation of this gap?

This chapter addresses these questions by exploring via simulation the effect of different educational choices and structural features of the society on both what the individual knows and on what information is considered "social" by the child and by the parent. The simulation model used is CONSTRUCT1, a model based on constructural theory, a cognitively and socially based theory of individual and social development. Using CONSTRUCT1, changes in social knowledge for a family, cultures within a society, and the society as a whole are tracked for a set of 36 societies. These societies differ initially in terms of social structure, educational choice, and family size. Like earlier work on self-construction, social structure as in the size of the population and the composition of groups, will be treated as static. Social knowledge, however, will be treated as dynamic.

The model to be presented centers around the acquisition, exchange, and utilization of information or knowledge. Prior to presenting this model, two questions need to be addressed. What is the relationship between individual knowledge and social knowledge; that is, how can we go from the self to the social? And, why is knowledge a key construct in understanding the interface between self and society?

To address the relationship between individual and social knowledge the following assumption is made. Knowledge is divisible into a set of discreet items, for example, *I am an artist* and *Artists look at the world differently than psychologists*. Individuals either know a piece of information or they do not. Individuals share information, if they both know that piece of information. Social knowledge thus becomes that information which is shared by a majority of individuals in the society.² Defined in this way, social knowledge has the properties associated with it when people talk about social knowledge as mediating the relationship between self and society.

That knowledge is a key construct in understanding the interface between self and society has been argued in a variety of ways, not the least of which are the almost axiomatic claims that (a) individual behavior is predicated on what information the individual knows (e.g., Goffman, 1963; Heise, 1987; Smith-Lovin, this volume); (b) interaction opportunities affect what information the individual knows (e.g., Granovetter, 1973, 1974); and (c) interaction opportunities affect what information is currently salient (Heise, 1987; Smith-Lovin, this volume; Burke & Reitzes, 1981; Stryker, 1980; Turner & Billings, this volume). Further, it has been argued that social knowledge performs a variety of interfacing functions. Consider the following. Social knowledge constrains behavior by limiting, for a particular task or social situation, the range of possible interpretations

of the available information. Thus, social knowledge enables such feats as story understanding and interpreting newspaper headlines (Schank, 1975; Lehnert, 1981; Rumelhart, 1976; Wilensky, 1981; Carbonell, 1981; Schank & Riesbeck, 1981; Schank & Abelson, 1977), and behaving in a restaurant or a doctor's office (Schank & Abelson, 1977; Heise, 1977, 1979, 1987; Smith-Lovin, 1987a, 1987b, this volume; Goffman, 1974). Social knowledge can be used to judge social membership. That is, one way of distinguishing groups is by whether or not the members of that group share a core set of knowledge that is distinct from other groups. Individuals are judged to be part of that group on the basis of whether or not they share that core set of knowledge. For example, in science shared paradigms can segregate individuals into groups (Price, 1963, 1965; Price & Beaver, 1966; Crane, 1970). Social knowledge is necessary in order for the individual to establish his or her frame of reference, make decisions, and perform tasks (Heider, 1958; Festinger, 1954; Wegner & Vallacher, 1977; Goffman, 1974; Rumelhart, 1978b; Schank & Abelson, 1977). Social knowledge is assumed by members of the society, and is necessary for interpreting communications (Whorf, 1956, Rumelhart, 1978a, 1978b; Collins, Brown, & Larkin, 1977; Charniak, 1972). Social knowledge can be thought of as shared culture or social background information (Polanyi, 1962; Whorf, 1956; Cicourel, 1974; Bar-Hillel, 1960; Carley, 1986a, 1986b). Without social knowledge the members of the group would have no common basis that would admit discussion, let alone agreement (Shibutani, 1961; Cicourel, 1974; Carley, 1984).

Despite the importance of knowledge, and in particular social knowledge, to social behavior, analytic models of the dynamics relating knowledge, social knowledge, and knowledge acquisition have rarely been forwarded. An exception here is the work by Cicourel (1974), and to some extent that by Garfinkel (1968) and Garfinkel, Lynch, and Livingston (1981). Statements such as Cicourel's (1974: 86) that without such a base, "everyday interaction would be impossible for nothing could pass as 'known' or 'obvious,' and all dialogue would become an infinite regress of doubts" and Shibutani's (1961: 40) that "men are able to act together with relative ease because they share common understanding as to what each person is supposed to do" demonstrate both the importance of systematically and analytically examining the development and acquisition of social knowledge and the fuzziness with which the concept has been treated.

A great deal of research has, however, been devoted to understanding individual knowledge acquisition. It has been demonstrated that individual knowledge acquisition is a function of (a) the individual's interaction patterns (Festinger, Schachter, & Back, 1950; Festinger et al., 1947; Granovetter, 1973, 1974, 1982; Carley, 1984, 1986a, 1987b); (b) the oppor-

tunities for interaction (Festinger et al., 1947; Burt, 1980); (c) the individual's cognitive processes for acquiring information (Roloff & Berger, 1982; Laird, Newell, & Rosenbloom, 1987; Laird, Rosenbloom, & Newell, 1986a, 1986b; Carley, in press-a, in press-b); and (d) the way in which the information is structured (Winston, 1975; Carley, 1987a). Despite the dual importance of both social and cognitive factors on knowledge acquisition, most research has concentrated on either the cognitive aspects (e.g., Anderson, Spiro, & Montague, 1976; Collins & Gentner, 1978) or the social (e.g., Blau, 1977; Granovetter, 1974; Burt, 1973, 1980) to the exclusion of the other. In addition, most theories of individual knowledge acquisition either ignore social knowledge or treat it as a static item, thus overlooking that in the process of acquiring information, individuals are creating and recreating social knowledge (Garfinkel et al., 1981; Cicourel, 1974). In contrast, constructural theory treats knowledge acquisition as a function of both social and cognitive factors and it treats social knowledge as a dynamic entity that is continually constructed as individuals acquire information and the number of individuals that share a particular piece of information increases.

According to constructural theory the social and the cognitive worlds of the individual are being continuously constructed as individuals move through the series of tasks that constitute their daily lives. In performing these tasks individuals interact, communicate, and acquire knowledge. For the individual, knowledge acquisition and hence cognitive development, can and does occur as a by-product of human interaction. The individual's cognitive structure, that is, what is known and the relationship between pieces of knowledge, is continuously constructed as the individual moves through the series of tasks that constitute his or her daily experience. The social world is continuously constructed as tacit consensus and temporal regularities form across the individuals in the society. Much of the social world is thus an artifact of the parallel construction of individuals' cognitions and the physical act of interacting. The social world and the individuals' cognitive worlds develop reflexively. As individuals' knowledge bases coevolve, their propensity to interact changes and the social world changes. Thus, who you talk to affects what you know and what you know affects whom you talk to. For a more detailed discussion of constructural theory the reader is directed to Carley (1986a, 1990a).

Model – CONSTRUCT1

A basic premise of constructural theory is that interaction leads to shared knowledge and the amount of information individuals share relative to what they share with everyone else affects their level of interaction.

This model is based on this premise. A consequence is that the process of self-construction is viewed as a three-stage process: (1) Individuals interact; (2) they exchange information; and (3) on the basis of their information they reconceptualize their relationship to all other members of the society by determining whether or not they are more or less similar than they were previously, thus altering the likelihood that they interact in the future. Further, the individual's identity becomes both what information the individual knows and the individual's interaction propensities. To use other terms, the individual's identity is both the sum of what he or she knows and who his or her friends are.

Individual behavior

Individuals are characterized by their propensity to interact with other members of the society and by the information that they know. These two characteristics control future interactions and exchanges of information. The individual's life is modeled as a series of interactions – reconceptualization moments. Each time period the individual first interacts with someone, perhaps himself or herself. The individual can interact with at most one other person during this time period. Mass communication is beyond the scope of this model. During this interaction information is exchanged. After all individuals have interacted they reconceptualize their relationships to all other individuals in the society.

Whether or not two individuals interact is a function of their interaction propensities. Each individual, i , has a nonnegative propensity to interact with every other member of society, j :

$$0 \leq INTPRO_{ij}(t) \leq 1$$

Each time period, the individual must interact:

$$\sum_{j=1}^{I(t)} INTPRO_{ij}(t) = 1$$

This interaction, however, may be with one's self, $INTPRO_{ii} \geq 0$; for example, when having an internalized conversation. The interaction propensity is a subjective facet of individual behavior. Consequently, $INTPRO(t)$ is not necessarily symmetric, that is, it may be the case that

$$INTRO_{ij}(t) \neq INTPRO_{ji}(t)$$

Whether or not two individuals actually interact is a chance occurrence weighted by the initiating individual's propensity to interact with the in-

dividuals who are not already interacting with someone else. That is, a forward chaining search for the most likely interaction partner is conducted among the remaining individuals. By definition, if there are an odd number of people in the society, then each time period at least one individual will partake in self-interaction. Due to this process, the propensity to interact and actual interaction are expected to be highly correlated, although not identical.

The individual, i , knows a set of information. At any point in time there are a number of pieces of information that are potentially available to the members of the society for communication: $K(t)$. Potentially available information includes that information that is known by at least one member of the society. For each piece of the potentially available information, k , the individual either knows or does not know that information:

$$KB_{ik}(t) = \begin{cases} 1 & \text{if } i \text{ knows } k \text{ at time } t \\ 0 & \text{if } i \text{ does not know } k \text{ at time } t \end{cases}$$

The information known by the individual forms the individual's knowledge base. Individuals do not forget information that they know; that is,

$$\text{if } KB_{ik}(t) = 1, \quad \text{then } KB_{ik}(t + 1) = 1$$

Consequently, over time the size of the individual's knowledge base grows:

$$\sum_{k=1}^{K(t)} KB_{ik}(t) \leq \sum_{k=1}^{K(t+1)} KB_{ik}(t + 1).$$

The knowledge representation scheme described is list structured. That is, each piece of information is distinct and unrelated to the next. There is no intrinsic way to link pieces of information together using this scheme.³

Each time an individual interacts there is the possibility that the individual will acquire a piece of information and communicate a piece of information. Whether or not the individual acquires or communicates information is a function of the type of communication channel with the interaction partner and the individual's current knowledge base.

The communication channel between two individuals (CC_{ij}) defines who can send information:

$$CC_{ik} = \begin{cases} > 0 & \text{if } i \text{ can send information to } j \\ 0 & \text{if } i \text{ cannot send information to } j \end{cases}$$

The communication channel is not time dependent. The interaction propensities reflect the communication channel. That is, if two individuals cannot send information to each other, their propensity to interact with

each other is zero. Two individuals can interact even if the communication channel is unidirectional. If the channel is unidirectional, then only one of the individuals can send information and the other individual can only receive information, and who can send or receive does not change over time.

There are two ways in which the individual can acquire information – via independent discovery or communication. Independent discovery can occur only if the individual is self-interacting. During self-interaction the individual can discover new information or reflect on known information. If the individual is interacting with another individual, then knowledge acquisition can occur only if knowledge can be and is communicated. Thus, if individuals i and j are interacting, j will learn information as long as the communication channel is open ($CC_{ij}(t) > 0$) and i has something to communicate. An individual has something to communicate if at least one piece of information is known. That is, an individual can only communicate a piece of information if it is currently in his or her knowledge base:

$$i \text{ can communicate } k \text{ if } KB_{ik}(t) = 1$$

All pieces of information known by the individual are equally likely to be communicated. An individual always accepts, that is, learns, a communicated piece of information, unless he or she already knows it.

The level of shared knowledge, SK , is the intersection of the two individuals' knowledge bases:

$$SK_{ij}(t) = \sum_{k=1}^{K(t)} KB_{ik}(t) \cap KB_{jk}(t)$$

The relative level of shared knowledge, RSK , for two individuals is defined as:

$$RSK_{ij}(t + 1) = \frac{\sum_{k=1}^{K(t)} KB_{ik}(t) \cap KB_{jk}(t)}{K(t)}$$

After each round of interaction the individuals automatically reposition themselves cognitively on the basis of relative shared knowledge; that is, they reconceptualize their identity and redetermine with whom they are most similar. This causes an adjustment in their interaction propensities:

$$Adjustment_{ij}(t) = RSK_{ij}(t) - \frac{\sum_{j=1, j \neq i}^{I(t)} RSK_{ij}(t) + \sum_{i=1, i \neq j}^{I(t)} RSK_{ji}(t)}{2 \times (I(t) - 1)}$$

The individual's interaction propensity changes through a small adjustment in the individual's previous interaction propensity. If individual i is now more cognitively similar to individual j than to others, that is, $Adjustment_{ij}(t) \geq 0$, then i 's propensity to interact with j increases:

$$INTPRO_{ij}(t) = \frac{INTPRO_{ij}(t-1) + Adjustment_{ij}(t) \times (1 - INTPRO_{ij}(t-1))}{\sum_{j=1}^{I(t)} INTPRO_{ij}(t)}$$

Whereas if they are less cognitively similar, that is, $Adjustment_{ij}(t) < 0$, then the interaction propensity decreases:

$$INTPRO_{ij}(t) = \frac{INTPRO_{ij}(t-1) + Adjustment_{ij}(t) \times INTPRO_{ij}(t-1)}{\sum_{j=1}^{I(t)} INTPRO_{ij}(t)}$$

At the individual level, interaction propensities will track shared knowledge. At the social level, social structure – shared patterns of interaction – will track sociocognitive structure – shared patterns of knowledge.

Groups

Groups can be defined on the basis of a priori information. For example, in this chapter one group is the set of all parents, another group is the set of teachers. An individual may be in more than one group. What group(s) the individual is in does not directly affect individual behavior.

Implementation

The model just described was implemented as a computer simulation model that is referred to as CONSTRUCT1. CONSTRUCT1 has been used to explore the relationships among social structure, interaction, and consensus (Carley, 1987a), and to investigate social stability (Carley, 1990b). CONSTRUCT1 is also described in Carley (1987a, 1988). A modified version appears in Carley (1990a).

Given a description of a society CONSTRUCT1 simulates interactions between individuals, the resultant acquisition of knowledge, and the development of shared and hence social knowledge. CONSTRUCT1 takes as input a text file containing a description of a society and produces as output text files of various statistics at the overall social, subculture, or dyad level.

Table 1. *Parameters to describe society*

Parameter	Representation
Length of simulation	Number of interaction-reconceptualization cycles
Number of people	Defined a priori Membership list
Number of groups	
Group characteristics	
Number of pieces of information	
Interaction propensities	A matrix indicating for each dyad their initial propensity to interact
Distribution of knowledge	A matrix indicating for each individual for each fact whether or not the individual initially knows that fact
Rate of immigration	Number of new people who enter society each time period (actual or as percentage of current population)
Startup values for immigrants	Initial interaction propensities and knowledge for each immigrant
Rate of emigration	Number of individuals in society who leave each time period (actual or as percentage of current population)
Rate of rediscovery	Frequency with which individuals discover a fact that is new to them but already known by someone in the society
Rate of discovery	Frequency with which a fact that is new to the society is discovered
Amount of fixed knowledge	Number of facts that individuals may or may not know that cannot be communicated. This can be interpreted as facts about self that cannot be changed such as age or sex.
Social knowledge level	Percentage of group that must know a fact for it to be considered social

These statistics can be produced for each of several time periods. The society is described by providing values for the set of parameters described in Table 1.

The model is analyzed via simulation because it is mathematically intractable for societies with even moderate numbers of individuals and pieces of information, for example, five people and seven facts. Simulation offers the advantage of being able to explore individual and social behavior in more realistically sized groups. A drawback to the simulation approach is that the behavior of the model, and hence the behavior of the societies explored, can only be approximated.

Method

This chapter uses simulation to explore the relationships among social structure, educational choice, and family size and their effects on the development and acquisition of social knowledge. Using CONSTRUCT1 36 societies are simulated, each for 100 time periods. Statistics on the acquisition and development of social knowledge are collected for each time period. Using these statistics it is possible to consider whether, across each society, children learn that information that is social for their parents or develop their own social knowledge, and whether the gap in children's and parents' social knowledge increases or decreases over time. Since statistics on a single family are also collected, it is possible to contrast social knowledge acquisition within a prototypical family to that in the society as a whole.

Societies modeled

A set of 36 distinct societies was created by varying three basic social parameters: the base social structure, the educational choice, and the number of children per family. The base social structure reflects the overall homogeneity of the society. Three different base social structures are explored: the homogeneous society, the heterogeneous society, and the two-culture society. Educational choice reflects the way in which children are educated in the society. Three different educational choices are explored: state-operated day care, private day care, home care. In both of the day-care situations it is assumed that children and parents still interact. Four different levels of the number of children per family are explored: 1, 2, 3, and 4. In all other ways, the societies are set up to be comparable, for example, with a similar number of people and the same number of pieces of information. Refer to Table 2 for those parameters that are held constant across all 36 societies.

Each of these 36 societies is characterized by a specific pattern of interaction propensities and a specific pattern in the distribution of knowledge. These are initial descriptions. Given the dynamic nature of CONSTRUCT1 the pattern of knowledge and interaction propensities can change over time. All societies simulated are comparable in size. Within these societies three types of individuals are identified – parents, children, and teachers – as family units – two adults and n children.

Interaction propensities are described in terms of levels. For example, Zebadiah and Aaron have an interaction propensity at level 5, Zebadiah

Table 2. *Social parameters held constant*

Parameter	Value	Parameter	Value
Length of simulation	100	Number of people	*
Rate of immigration	0	Number of groups	*
Rate of emigration	0	Number of pieces of information	100
Rate of rediscovery	0	Startup values for immigrants	random
Rate of discovery	0	Interaction propensities	*
Size of fixed knowledge base	0	Knowledge base	*

* Items are varied for different societies.

and Deety at level 5, and Deety and Aaron at level 2. Levels indicate the relative ratio of the interaction propensities to each other. Given the level of interaction propensity, L_{ij} , between all dyads, the actual interaction propensity can be found by:

$$INTPRO_{ij} = \frac{L_{ij}}{\sum_{j=1}^{I(t)} L_{ij}}$$

A set of assumptions is made in setting up all societies. Individuals are assumed to interact more with family members than with nonmembers. This is represented by giving family members an interaction level of 4 with each other and lower levels of interaction with non-family members. Individuals are assumed to spend most of their time interacting with others. This is represented by giving each individual an interaction level of 1 for interacting with themselves. Parents are assumed not to interact with teachers (level 0). Parents are assumed to interact only with their own children (interaction with other children is set to level 0). Children are characterized as starting out with no knowledge. Children interact with their own parents, other children, and teachers. All teachers know the facts that are social knowledge for their community (see section on groups and initial shared knowledge). All teachers at the same day-care facility know the same set of facts. Teachers interact with children and other teachers. If there are teachers, then the number of teachers is one-third the number of children. Teachers interact more with children than with other teachers. Children interact more with teachers than they do with other children. This is modeled by setting the teacher-child interaction level to 3. Teachers can communicate information to children but cannot learn from children. Although these assumptions are not entirely realistic, they do

present a description of society that is plausible. Further, these assumptions make the societies modeled distinct and characteristic of different sociocultural environments. Thus, if there are effects from varying the structural parameters (social structure, educational choice, and family size) such results will be observable.

Social structure. In the homogeneous society there is a uniform level of interaction between non-family members, and a high level of shared knowledge. This is modeled by setting the level of interaction between parents, excluding spouse, and the level of interaction between children, excluding siblings, to level 2, and by having each parent know 75% of the facts. In the heterogeneous society there is a lower overall level of interaction and less uniformity in the interaction, and there is a lower level of shared knowledge. This is modeled by setting the level of interaction between parents, excluding spouse, and the level of interaction between children, excluding siblings, to either level 1 or 2 determined randomly. Each parent knows 40% of the facts. In the two-culture society the society is divided into two subcultures each with an equal number of parents and children. The set of facts is divided in half, so that one-half is associated with each subculture. Within a subculture the individuals are treated as a homogeneous society, whereas there is less interaction and shared knowledge between subcultures. The level of interaction between parents in different subcultures, and between children in different subcultures is set to level 1. Each parent knows 15% of the other subculture's facts. Regardless of the social structure, which facts are known by whom is determined at random.

Educational choice. Whether or not there are teachers depends on the educational choice. What knowledge two teachers share and what knowledge a teacher shares with other members of the society depends on the educational choice. If there are teachers and it is the two-culture society, then the teachers are equally divided between the two subcultures. When the choice is state-operated day care all children go to the same set of teachers. When the choice is private day care there are two day-care centers with half of the teachers in each center, and which children go to which center is chosen on the basis of social knowledge shared between parents and teachers. When the choice is home care there are no teachers.

Number of children per family. A family unit is composed of two parents and a certain number of children. Four different sizes of family units are explored, those with one, two, three, or four children. When the family

unit has four children there are 16 family units in the society. When the family unit has three children there are 20 family units in the society. When the family has two children there are 26 family units in the society. When the family unit has one child there are 36 family units in the society.

Groups and initial shared knowledge

In order to determine whether the gap in social knowledge for parents and children changes over time at the family, subculture, or societal level the following groups are identified. For each group, social knowledge can be identified. A piece of information is considered to be social knowledge for a group if 60% of the individuals in that group know that piece of information. Since children start out with no knowledge, they have no initial social knowledge. There are two societal-level groups, four subcultural-level groups, and two family-level groups.

All parents. This group contains the complete set of parents. If the social structure is the homogeneous society or the heterogeneous society, then the social knowledge for this group are those facts that are known by 60% of all parents in the society.

All children. This group contains the complete set of children.

Parents group 1. This is the first half of the parents in the society simulated.

Parents group 2. This is the second half of the parents in the society simulated.

Children group 1. This is the first half of the children in the society simulated.

Children group 2. This is the second half of the children in the society simulated.

If the social structure is the homogeneous society or the heterogeneous society, then there is no systemic difference between the first and second group of parents or children. Any apparent difference is the result of chance. If the social structure is the two-culture society, then the two groups differ systemically both in the pattern of their interaction propensities and the distribution of knowledge. Further, if the social structure is

the two-culture society, then group 1 data is for one subculture and group 2 is for the other subculture.

Teachers group 1. If the educational choice is state-operated day care, then all teachers are in this group. The social knowledge for the group is the social knowledge for all the parents in the society. If the educational choice is private day care, then the first half of the teachers are in this group. In this case, these teachers share the social knowledge of the first group of parents.

Teachers group 2. There is a second group of teachers only if the educational choice is private day care. If there is a second group of teachers, these teachers will share the social knowledge of the second group of parents.

Family parents. This group contains the parents of a particular family selected at random. A fact is considered to be a social knowledge for this group if both parents know it.

Family children. This group contains the children in the selected family.

Measures

For each time period the following measures are collected for the society as a whole, for each subculture, and for the selected family: total social knowledge, amount of original social knowledge, amount of new social knowledge, and amount of unique social knowledge. Using these measures the information gap between children and parents can be calculated. The last three of these measures are based on knowing what information was originally social knowledge for the parents. The parents' original social knowledge is the set of facts that were known by 60% of the parents in that group at time 0.

Total social knowledge. This is measured as the number of facts that are known by 60% of the individuals in the group at that time. This is referred to as *total*.

Amount of original social knowledge. This is measured as the number of facts that are known by 60% of the individuals in the group at that time and that were part of the original social knowledge for the corresponding

parents' group. This is referred to as *original*. For groups of parents the amount of original social knowledge is constant over time.

Amount of new social knowledge. This is measured as the number of facts that are known by 60% of the individuals in the group at that time and that are now social for the corresponding parents' group and that were not originally social for the parents. These facts are referred to as *new*. For groups of parents $new(t) = total(t) - original$.

Amount of unique social knowledge. This is measured as the number of facts that are known by 60% of the individuals in the group at that time and that are not social for other corresponding groups. These facts are referred to as *unique*. For groups of children $unique(t) = total(t) - new(t) - original(t)$.

Three measures of the information gap between children and parents are calculated: $gap(0)$, $gap(100)$ -original, and $gap(100)$.

Gap(0). This is the gap in parents' and children's social knowledge at time 0. Since the children begin by not knowing anything, this is just the number of facts that are originally social for the parents.

Gap(100)-original. This is the gap in parents' and children's social knowledge that is measured when the parents' social knowledge is treated as static. It is measured as the difference in the amount of original social knowledge for the parents and the amount of original social knowledge for the children.

Gap(100). This is the gap in parents' and children's social knowledge that is measured when the parents' social knowledge changes over time. It is measured as the difference in the total social knowledge for the parents and the original and new social knowledge for the children.

Results

This analysis provides a variety of insights into the acquisition of social knowledge at the family, subculture, and societal level. A variety of these findings are general, that is, based on the average behavior across all 36 societies simulated (see Table 3).

Knowledge becomes social for children very slowly. For both the society and the subculture in 100 time periods only an average of 18 pieces of

Table 3. General results for children (amount of social knowledge for that group at time 100)

Level	Total	Original	New	Unique	Gap (0)	Gap (100)-original	Gap (100)
Social	18.19	9.31	8.22	0.66	48.75	39.44	79.14
Subculture	18.03	12.17	3.52	2.34	62.58	50.41	71.37
Family	41.86	17.47	22.09	2.30	42.67	25.20	55.13

information come to be shared by the children. Within a particular family, however, the children in that family may come to share much more information with each other than all children in the society share; however, the variance across families is quite high (mean = 41.86, sd = 34.59). What about the information gap between parents and children? If we looked only at the knowledge that was part of the parent's original social knowledge, it appears that (a) there is still a large gap (see gap(100)-original column in table), and (b) this gap has decreased, albeit slowly, over time (see difference in gap(0) and gap(100)-original columns). This is true regardless of the group level. And the decrease in the gap may be the most pronounced at the family level. During this time, however, both children and parents have been acquiring new information. The parents at time 100 have new social knowledge. When this knowledge is considered the gap between parents and children actually increases over time (see gap(100) column). This, also, is true regardless of level. The increase in this gap appears the worst at the overall social level.

At the societal level, children sometimes develop social knowledge that is different than the parents' social knowledge. This happens in 10 of the 36 societies. This generally happens in two-culture societies (9 of the 10 societies).

The impact of social structure, educational choice, and family size on social knowledge acquisition and development is complex. These structural factors do impact the rate at which children acquire the parents' original social knowledge, the parents' new social knowledge, and social knowledge that is not shared by the parents. Regardless of level of analysis or which of these structural features is considered, if parental social knowledge had been treated as static, the gap between children and parents appears to decrease over time. Whereas, when you take into account that the parents are also learning new information the gap is seen to actually increase (contrast the difference between gap(0) and gap(100)-original, and the difference between gap(0) and gap(100) in tables 4, 5, and 7).

Table 4. *Social structure results for children (amount of social knowledge for that group at time 100)*

Level	Total	Original	New	Unique	Gap (0)	Gap (100)- original	Gap (100)
<i>Homogeneous</i>							
Social	15.67	15.50	0.17	0.00	98.00	72.50	84.33
Subculture	15.92	14.67	1.25	0.00	91.75	77.08	83.83
Family	39.25	23.58	15.67	0.50	60.00	36.42	60.08
<i>Heterogeneous</i>							
Social	17.00	12.25	3.57	0.08	47.75	35.50	82.91
Subculture	16.67	11.58	4.92	0.17	50.00	38.42	82.08
Family	40.92	15.33	25.00	0.59	38.00	22.67	57.34
<i>Two-culture</i>							
Social	21.92	0.17	19.83	1.92	0.50	0.33	70.17
Subculture	21.50	10.25	4.42	6.83	46.00	35.75	48.16
Family	45.42	13.50	26.00	5.84	30.00	16.50	40.00

Effect of social structure

Social structure does affect the acquisition of social knowledge (refer to Table 4). The less homogeneous the society, the more social knowledge the children develop (see total column), the more social knowledge children develop that is not shared by the parents (see unique column), and the smaller the gap between parents and children. For both a homogeneous and a heterogeneous society at both the subculture and societal level, children learn more of the parents' original social knowledge than of the parents' newly acquired social knowledge. For a two-culture society children will adopt more unique social knowledge, that is, knowledge that is not shared by the parents, than will the children in either the homogeneous or heterogeneous societies. This is an indicator that the two-culture society is inherently unstable. Children in such societies are prone to develop their own set of social knowledge, thus changing the character of the society. At the family level children learn the most of the parents' original social knowledge if the social structure is homogeneous.

In a highly homogeneous society children are most likely to learn the parents' social knowledge because interaction with other children and teachers tends to reinforce the values taught at home, whereas in the heterogeneous society and the two-culture society children are less likely to adopt their parents' original social knowledge as there is less reinforcement outside the family. This lack of reinforcement may also be seen as

Table 5. Educational choice results for children (amount of social knowledge for that group at time 100)

Level	Total	Original	New	Unique	Gap (0)	Gap (100)-original	Gap (100)
<i>State</i>							
Social	19.33	11.25	6.92	1.16	48.75	37.50	76.16
Subculture	19.00	13.00	3.25	2.75	62.58	49.58	69.33
Family	42.92	17.83	25.09	3.00	42.67	24.84	53.08
<i>Private</i>							
Social	20.67	10.42	9.75	0.50	48.75	38.33	77.16
Subculture	20.75	14.42	4.00	2.33	62.58	44.16	69.08
Family	45.67	19.50	24.08	2.09	42.57	23.17	51.50
<i>Home</i>							
Social	14.58	6.25	8.00	0.23	48.75	42.50	84.08
Subculture	14.33	9.08	3.34	1.91	62.58	53.50	75.66
Family	37.00	15.08	20.09	1.83	42.67	27.67	60.83

encouragement to adopt the knowledge of the entire society, or socialization not to the subculture but to the society. Thus children develop more social knowledge in the two-culture society and the heterogeneous society that is not shared by their parents. At the same time, however, the parents are also being socialized. Thus as the society is less homogeneous, the actual gap between parents' and children's social knowledge will decrease but the uniqueness of the children's social knowledge will increase.

Effect of educational choice

Educational choice also influences the acquisition and development of social knowledge (refer to Table 5). At the social and subculture level when either state or private day care is used, most of the social knowledge acquired by the children is part of the parents' original social knowledge. Both state and private care lead to the children gaining more social knowledge that is unique. The more children are segregated (private and home care versus state care), the greater the gap between parents and children (gap(100) and gap(100)-original columns) and the less the gap decreases over time (difference in gap(0) and gap(100)-original columns). Segregation, however, does not lead the children to necessarily develop more social knowledge.

Administrators will perceive children overall as acquiring the most original social knowledge if the form of day care is state day care. At the

Table 6. *Educational choice results by society for children (amount of social knowledge, subcultural level, at time 100)*

Level	Total	Original	New	Unique	Gap (0)	Gap (100)- original	Gap (100)
<i>State</i>							
Homogeneous	16.75	15.75	1.00	0.00	91.75	76.00	83.25
Heterogeneous	18.75	13.25	5.00	0.00	50.00	36.75	79.50
Two-culture	21.50	10.00	3.25	8.25	46.00	36.00	45.25
<i>Private</i>							
Homogeneous	18.75	17.00	1.75	0.00	91.75	74.75	80.75
Heterogeneous	18.25	13.75	4.25	0.25	50.00	36.25	80.50
Two-culture	25.25	12.50	6.00	6.75	46.00	33.50	46.00
<i>Home</i>							
Homogeneous	12.25	11.25	1.00	0.00	91.75	80.50	87.50
Heterogeneous	13.00	7.75	5.00	0.25	50.00	42.25	86.25
Two-culture	17.75	8.25	4.00	5.50	46.00	37.75	53.25

social or subcultural level in a private day-care system children will acquire less of the parents' original social knowledge, more of the parents' new social knowledge, and less unique social knowledge than they will in either the state or home care system. When home care is used overall children acquire the least of the parents' original social knowledge.

Thus, at the social level, state day care leads to the most stability in terms of social knowledge transference. If parents want their children to adopt their original social knowledge, they are better off sending them to either state or private day care than keeping them at home. That is, home care does not guarantee that the original social knowledge will be transferred within the family.

At the subculture level, a private day-care choice leads to the highest transference of the parents' original social knowledge. Thus for a subculture, developing private day care for the subculture helps ensure the transfer of original social knowledge. This is true even if that subculture is arbitrarily formed, as in the case of the arbitrary homogeneous and heterogeneous subcultures (see Table 6). In homogeneous societies, regardless of type of day care, children adopt more of the parents' original social knowledge. Home care leads to the lowest transference of parents' original social knowledge to the children.

In the two-culture society home care leads to the children acquiring the least unique knowledge, that is, social knowledge not shared by parents.

Table 7. Family size results for children (amount of social knowledge for that group at time 100)

Level	Total	Original	New	Unique	Gap (0)	Gap (100)- original	Gap (100)
<i>1 child</i>							
Social	17.00	9.22	7.11	0.67	49.00	39.78	80.11
Subculture	17.22	11.33	2.67	3.22	65.00	53.67	71.44
Family	10.00	42.67	51.22	6.11	42.67	0.00	0.00
<i>2 children</i>							
Social	18.78	8.78	9.33	0.67	48.33	39.55	79.45
Subculture	19.00	12.78	3.44	2.78	65.00	52.22	70.56
Family	24.44	8.44	14.56	1.44	37.67	29.23	71.67
<i>3 children</i>							
Social	18.89	10.00	8.44	0.45	48.00	38.00	77.89
Subculture	18.44	12.22	4.67	1.55	57.00	44.78	71.89
Family	19.56	9.11	9.89	0.56	45.00	35.89	76.33
<i>4 children</i>							
Social	18.11	9.22	8.00	0.89	49.67	40.45	79.11
Subculture	17.44	12.33	3.34	1.77	63.33	51.00	71.55
Family	23.44	9.67	12.66	1.11	45.33	35.66	72.56

When children are educated at home, however, the greatest gap between children and parents occurs and the decrease in this gap over time occurs at the slowest rate. Again, the lack of reinforcement from teachers leads to the children not learning as much of their parents' social knowledge as they could. Further, when the children interact with other children, including those outside their culture, they acquire not only new information but information not shared by their parents. Going to school has a reinforcing effect not because it prohibits children from interacting, but because it educates all children with the same information so that when they interact with each other they reinforce this information.

Effect of family size

Family size, that is, the number of children in the family, has little impact on the acquisition and development of social knowledge when viewed at the social level. At the family level, however, it has a major impact (refer to Table 7).

The relationship between family size and social knowledge is complex. Within a family single children may quickly learn that knowledge that

is social for their parents, thus decreasing the gap between children and parents, whereas at the social level, if all the children are single children, the gap between children and parents will be the highest. It is not the case that the more children in the family, the lower the gap or the higher the gap. For families with either two or four children, less of the parents' original social knowledge is learned, more unique social knowledge is developed, the overall gap is higher, and the decrease in the original gap is less. When there are fewer children (two and three as opposed to four), children acquire more of the parents' new social knowledge.

Conclusion

Constructuralism is a theory about the relationship between the cognitive world of the individual and the social world, that is, about the interface between self and society. According to this theory the social world is continually reconstructed as regularities form across individuals who are in a continual process of self-construction. In this chapter, one of the basic tenets of constructural theory – that interaction leads to shared knowledge and relative shared knowledge leads to interaction – was applied to the area of education.

This chapter illustrates how a cognitively based model of the individual can be used in conjunction with a model of communication to examine both individual and social behavior. The information presented demonstrates that valuable insights regarding the self-society interface can be drawn even when a simplistic model of cognition and a simplistic model of the self-construction process is used. This chapter also demonstrates that social change, modeled herein as change in social knowledge, can occur simply because all individuals in the society are simultaneously constructing their notions of self.

This work, like that of Heise and Smith-Lovin on affect control theory (Heise, 1977, 1978; Smith-Lovin, this volume), utilizes a mathematical modeling and simulation approach. Such an approach is extremely valuable for sociology as it allows us to develop experimental testbeds where questions of self and social change can be explored and the implications of complex theories precisely derived. Such models can be used to examine how sensitive empirical findings are to small changes in structural factors, such as the ratio of groups sizes, over which the data analyst may have little control. Further, such models can be used to noninvasively study the potential impact of social policies prior to their implementation. As our theories increase in complexity and become more dynamic, mathematical modeling and simulation become increasingly important tools for doing

theory development. It is important to be careful in applying these models, however, as the modeling task necessitates not only being precise but simplifying. For example, in the analysis in this chapter, it was assumed that over the time period examined individuals did not forget and no discoveries were made.

In this study, through simulation a variety of predictions and explanations can be derived from constructural theory. These were listed in the previous section as results. Let us reconsider two of these.

The model suggests that if parents' social knowledge is treated as static, then the gap between parents and children should decrease over time, whereas, given that the parents are also learning, the gap should actually increase. Anecdotally, there is evidence that this is the case; that is, parents complain more of not understanding their teenagers than they do their toddlers. In addition, intergenerational tension not only does exist but appears to mark the transition of children to independence and adulthood (Berkner, 1972; Netting, 1981). The explanation for this transition is often given in terms of there being a difference in power, wealth, and status between adults and children and the parents being unwilling to transfer to the children the means of production. Constructural theory, on the other hand, suggests that the tension is the result of an intergenerational gap in information, a gap that is inevitable as long as both children and parents continue to acquire information.

The model also suggests that children who are more isolated, for example, those educated at home, will be less likely to acquire social knowledge, will be less likely to acquire parents' original social knowledge, will be less likely to acquire information different than their parents', and will exhibit greater intergenerational gaps. Due to the presence of fewer interaction partners, children educated at home will acquire less information overall, including social knowledge. In the literature it is generally argued that schooling, by increasing economic opportunities, literacy, and opportunities for accessing more new ideas than their parents, has increased the educational gap between children and parents (Ogburn & Nimkoff, 1955; Thornton & Fricke, 1987; Caldwell, 1982). Constructural theory suggests that schooling does not necessarily lead to a gap. Schooling will lead children to acquire information not shared by their parents. In addition, schooling will reinforce the knowledge taught at home. Thus schooling may actually decrease the gap between children and parents.

In interpreting this last prediction it is important to remember that direct interaction with an actual other, for example, face-to-face exchanges, is not distinguished from indirect interactions with a symbolic other, for example, through reading a book. Thus, the prediction that children with

fewer interaction partners learn less social knowledge means children who play with fewer other children, who talk to fewer adults, and who read fewer books are more isolated in all these respects and acquire less social knowledge. An interesting expansion of the model would be to disaggregate direct and indirect interaction and to explore their relative effects. Without such an extension, the model does suggest, however, that children educated at home, even if they read the same number of books and watch the same amount of TV and so on as other children, will still acquire less social information.

With respect to education and intergenerational gaps, this chapter demonstrates that observed behavior can be explained by the simple process of interaction that leads to shared knowledge and shared knowledge relative to others leads to interaction. Differentials between parents and children in terms of control over the means of production, literacy, access to new technology, and motives are not needed to produce intergenerational gaps. This suggests that by clearly specifying the mechanisms of self-construction we will be able to produce more parsimonious theories.

It is clear that the social context influences individuals' behavior and the construction of self (e.g., Stryker, this volume; Schwalbe, this volume; Serpe, this volume; Howard, this volume; Smith-Lovin, this volume). In the model presented social context is represented by social structure (the set of groups and their interrelationships) and shared knowledge. In CONSTRUCT1 social contexts are not as differentiated as they are, for example, in affect control theory or role theory. To illustrate this, in CONSTRUCT1 whether a child interacts with a teacher or a parent, all the information known by the child is equally likely to be communicated. Thus, the context has no effect on what information is exchanged. If a more complex scheme for representing information were used, then in fact context effects on information exchange might be able to be explored. This is one direction in which constructural theory could be expanded.

Since the social context is generally treated as static, the dynamics of individual behavior in a changing society and the dynamics of change for the society are rarely explored. In this chapter a framework for exploring such *dynamic concerns* has been forwarded. Using this framework it was demonstrated that individual change does lead to social change. It was also demonstrated that structural features of the sociocultural environment affect both individual and social change. And, finally, it was demonstrated that social policies by producing certain social structures – for example, the type of educational opportunities available – establish and limit interaction opportunities, thus affecting not only how the individual identifies himself or herself but the opportunity for social change or stability. All this is

to suggest that we cannot understand the self-society interface unless we situate our model of the constructed actor not only within social contexts, but within a dynamic model of social contextual change. If this is not done, then it is important to consider whether the propositions forwarded about individual behavior are in fact only short-term effects where the social context is relatively stable.

Notes

- 1 In this paper the terms *information*, *knowledge*, and *fact* will be used interchangeably.
- 2 This is an application to information of, and hence a simplification of, the meaning nominalist perspective (Grice, 1969; Bennett, 1976).
- 3 In CONSTRUCT1 there is no structure to the information. Hence CONSTRUCT1 is not a complete description of constructural theory as presented in Carley (in press-a, in press-b). This simplification is useful, however, as it makes it possible to address analytically the relationship between shared knowledge and interaction. This simplification is limiting in that it does not make it possible to address how organizing information into structures affects behavior. In fact, we know that it is not just how much information people know that determines their behavior but how that information is structured (Carley, 1987a; Morgan & Schwalbe, 1990; Fiske & Taylor, 1984).

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