Children and Adolescents’ Internal Models of Food-Sharing Behavior Include Complex Evaluations of Contextual Factors

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This study examined internal representations of food sharing in 589 children and adolescents (8–19 years of age). Questionnaires, depicting a variety of contexts in which one person was asked to share a resource with another, were used to examine participants’ expectations of food-sharing behavior. Factors that were varied included the value of the resource, the relation between the two depicted actors, the quality of this relation, and gender. Results indicate that internal models of food-sharing behavior showed systematic patterns of variation, demonstrating that individuals have complex contextually based internal models at all ages, including the youngest. Examination of developmental changes in use of individual patterns is consistent with the idea that internal models reflect age-specific patterns of interactions while undergoing a process of progressive consolidation.

The social world is, in many respects, much more complex than the physical world. A social actor is faced with a bewildering array of roles, norms, expectations, and behaviors, and one of the key developmental tasks facing children is being able to understand the rules of this complex world. Although some of these social rules may be explicitly transmitted verbally to children or consciously constructed by them, the sheer complexity of the social system makes it unlikely that most are directly available to conscious processing. Retrieval of a specific piece of information from a given set of choices rapidly becomes computationally intractable as the number of possible choices increases (referred to as the frame problem; e.g., McCarthy & Hayes, 1969). If people had to negotiate social interactions by accessing explicit rules, most interactions would require long periods of silence while people tried to determine what rules to use. Given the absence of long silences, other processes may account for the speed and fluidity that generally characterizes social interactions. One possibility is that children and adults encode key properties of their social world by constructing internal representations (Nelson, 1981; Schank & Abelson, 1977). Although these representations are not necessarily consciously accessible, they may be activated by general associative retrieval processes (Anderson, 1993). Activation of a given representation will then condition a social actor’s analysis of, and expectations for, a given social interaction (e.g., Karniol, 1985).

There is increasing evidence for representational models of social interactions that encode patterns of behavior (see Baldwin, 1992). Illustrative is attachment theory, which postulates the existence of an internal working model of the attachment relation (Bowlby, 1969, 1988) that represents patterns of responsiveness of a child’s caregiver (e.g., Furey, Carlson, & Sroufe, 1997; Kirsh & Cassidy, 1997; Main, Kaplan, & Cassidy, 1985; Oppenheim, Emde, & Warren, 1997). Such models are claimed to translate regularities in behavior into cognitive structures that in turn guide the way social information is processed (Baldwin & Meunier, 1999; Bowlby, 1969; Bretherton, 1990).

Likewise, researchers have recently begun examining internal representations of peer relations. For example, Dodge and Crick (1990; Crick & Dodge, 1996) found that aggressive children and nonaggressive children interpret social stimuli differently, differences that appear to be related to children’s underlying representational models of peers (Burks, Dodge, Price, & Laird, 1999). Von Hecker (1997) proposed that adults construct mental models (Johnson-Laird, 1983) of social situations that repre-
sent some basic elements of the structure of such interactions. Markovits and Dumas (1999) found that children develop expectations for friendship that correspond in nature to a form of social transitivity but are independent of logical transitivity. Markovits, Benenson, and Dolenszky (2001) observed that children’s internal representations of peer interactions contained gender-related differences that strikingly reflected complex patterns that were consistent with the results of observational studies. These results demonstrate that children can accurately encode many aspects of social interactions into internal models. The general aim of this study is to extend what is known about the structure and development of these models.

The major question we addressed concerns the way social information is encoded into internal models. One possibility would be to represent fairly simple relations (e.g., someone who plays with you is a friend). This could, however, involve an enormous number of specific models, thus placing high cognitive demands on individuals. In addition, there are indications that the social behaviors that are the basis for these models show complex forms of context dependency. The form of behavior we chose to examine is food sharing.

Sharing behavior is considered a crucial aspect of the evolution of human behavior by researchers from diverse disciplines including evolutionary biology, economics, and anthropology (e.g., Axelrod, 1984; Boyd & Richerson, 1988; Hamilton, 1964; Kaplan, Hill, Lancaster, & Hurtado, 2000). Individuals will punish those who do not share, even at some expense to themselves (Fehr, Fischbacher, & Gachter, 2002; Fehr & Gachter, 2002). The need to share food is considered a primary reason for the occurrence of sharing in traditional human cultures (e.g., Boehm, 1999) and a possible explanation for marriage (e.g., Marlowe, 2003).

Even in nonhuman animals, studies demonstrate that food sharing is a complex behavior governed by conditional rules, which involve context-modulated patterns of behavior (for review, see Kramer, 2001). For example, researchers who study hunting and food-sharing behavior in several species believe that certain basic contextual factors, such as biological relatedness and measures of liking such as proximity or grooming, hunger, and sex, modulate food-sharing behaviors (e.g., Boesch, 2002; Boesch & Boesch-Achermann, 2000; Scheel & Packer, 1991; Stander, 1992). Studies demonstrate that animals use complex, implicit evaluation strategies to weigh a variety of environmental conditions in determining their food-sharing behaviors.

There is some empirical data on sharing behaviors in humans that suggest the same kinds of context-related variation (e.g., Hartshorne & May, 1928; Loh & Elliott, 1998; Ma & Leung, 1993; Maras, Lewis, & Simonds, 1999). A recent study by Benenson, Markovits, Roy, and Denko (2003) examined kindergarten and fourth-grade children’s sharing behavior in two experimental contexts: one in which a resource could be hoarded without being easily detected, and the other in which hoarding could be easily detected. Results showed that at both age levels, the same children shared significantly more when hoarding could be easily detected than when it could not. This occurred at both age levels, with older children differentiating their behavior in the two situations more than younger children. These results show that individual sharing behavior varies as a function of context and suggest that, with increasing age, the effect of context becomes consolidated.

The present study examined the hypothesis that children’s and adolescents’ internal representations of food-sharing behaviors include complex evaluations of important contextual factors. Analyses of food sharing in traditional cultures focus on some of the same basic factors as in nonhuman animals: biological relatedness and measures of liking, hunger, and sex of provider and recipient of the food (e.g., Boesch, 1999; Hill, 2002). Although systematic studies are inherently difficult to conduct because of ethical considerations, we expect that individuals should quickly acquire implicit expectations concerning how food will be shared based on similar kinds of basic factors.

The first factor we examined was the nature of the relations between social partners (Fiske, 1992). We compared sharing among siblings, classmates, or strangers. Theories of kin selection suggest that individuals should share more with biological relatives than with nonkin (Hamilton, 1964). Existing evidence confirms that even with humans, sharing is greater among relatives than among nonrelatives (Loh & Elliott, 1998; Ma & Leung, 1993). Sharing among classmates and strangers should, in addition, reflect factors associated with reciprocal altruism and thus should vary according to the probability of the sharing being reciprocated in the future (Trivers, 1971); that is, sharing should be greater with classmates than with strangers who may not be encountered again.

The second factor we examined was the quality of the relationship, that is, whether social partners get along well. Again, compatibility would be expected to influence sharing, as individuals with whom one
is compatible would be expected to be more likely to reciprocate in the future (Trivers, 1971). There is some direct evidence of more sharing between partners who have a good relationship than otherwise (Ma & Leung, 1993).

The third factor was the survival value of the food. Both the kind of food and the context in which sharing occurred were varied to accentuate the difference in this variable in an ecologically valid way that was equally understandable to both children and older participants. In one, the food had a low survival value: a dessert biscuit in a park. In the second, the food had a high survival value: a sandwich in a forest in which the actors are lost, tired, and hungry. Clearly, in the high-survival-value context, sharing would be much more important. In traditional cultures, sharing under conditions of hunger is mandatory, and individuals who do not share food under such conditions are ostracized by the group (Boehm, 1999).

The fourth factor was gender. To limit the number of factors examined, we only compared male versus female providers with same-gender recipients. Some studies have found that females are expected to be more likely than males to share with one another (e.g., Jha, Yadav, & Kumari, 1998; Zarbatany, Hartmann, Gelfand, & Vinciguerra, 1985), although others have found little difference between females and males (e.g., Mills, Pedersen, & Grusec, 1989).

Finally, we examined several age groups, ranging from early primary (second grade) to university students. In this age range, there are well-documented changes in both explicit reasoning about the social world (e.g., Damon, 1990; Kohlberg, 1994) and logical reasoning (e.g., Byrnes & Overton, 1986; Markovits, Schleifer, & Fortier, 1989). These changes reflect the use of increasing cognitive resources to develop progressively more complex schemas (Case, Kurland, & Goldberg, 1982; Halford, Bain, Maybery, & Andrews, 1998). If the complex internal models that are postulated here required the kind of cognitively difficult coordination involved in explicit reasoning, one would expect the same pattern of developmental change, with reasoning going from simpler to more complex patterns. However, our basic hypothesis made a very different prediction. We assumed that construction of internal models is a process of unconscious encoding of observed patterns of interactions. Subsequent use of models is through associative processes that require relatively few cognitive resources. In this perspective, developmental change would reflect (a) age-related differences in social experiences and (b) the gradual consolidation of models as a result of increasing experience with the social world. There is some evidence to support this view. Markovits and Dumas (1999) found that reasoning about social transitivity was completely unrelated to logical transitive reasoning. Markovits et al. (2001) found that internal models of gender-related differences in social interactions were similar across a large age range, with the developmental pattern consistent with a consolidation hypothesis. Although this latter study did not involve the complex variation of factors examined here, we expected that this same pattern would characterize the models in this study.

We used the same basic method that was used in the Markovits et al. (2001) study, in which participants were asked to judge the probable outcomes of social interactions involving typical social actors. We presented participants with short scenarios accompanied by schematic (cartoon) drawings. Each scenario presented a situation in which a potential provider was shown receiving a given resource, and then a receiver was shown asking for the resource. Participants were asked to judge how much of the resource the provider really wanted to give to the receiver. This question was designed to access (implicit) expectations that are generated by internal representations of a given social situation (e.g., Baldwin, 1992). In these scenarios, the previously mentioned factors (nature of the social relation, quality [good, bad] of the relation, resource value, and gender) were systematically varied.

We had three goals in this study. First, we wished to determine whether expectations of sharing exhibit complex contextual variation. Second, we wanted to examine whether the developmental pattern of variation indicates a progressive increase in the complexity of these models or is consistent with a consolidation model. Third, we wanted to examine whether expectations of sharing are consistent with what is known about sharing behavior observed in empirical studies.

Method

Participants

Participants were 589 French-speaking students attending one of several schools in the Montreal area. Of these, 72 were in Grade 2 (41 girls, 31 boys; average age = 8 years 1 month), 66 in Grade 5 (41 girls, 25 boys; average age = 11.1), 141 in Grade 7 or Grade 8 (67 girls, 74 boys; average age = 12.11), 142 in Grade 10 or Grade 11 (54 girls, 88 boys; average age = 16.3), and 168 in university (92 girls, 76 boys; average age = 19.4). Participants primarily came
from mixed European backgrounds and were from middle- to lower-middle-class neighborhoods.

**Measures**

Written instructions (in French) explained that participants would read about situations involving a typical girl (or boy) interacting with another same-sex person (hereafter referred to as the provider) and that their job would be to judge what decision the provider would really want to make in each situation. In each scenario, it was stated that the provider could give all or a part of the resource in question (biscuit or sandwich) to another person (hereafter referred to as the recipient). Each resource could be divided into 10 equal pieces, any number of which could be given to the recipient.

Every participant was asked to respond to six scenarios, three of which involved the low-survival-value situation with sibling, classmate, and stranger, and three of which involved the high-survival-value situation with sibling, classmate, and stranger. Each of the six scenarios included two cartoon drawings, followed by text. A single scenario described the provider child and a same-sex, same-age recipient who was either a sibling, a classmate, or a stranger in either the low-survival-value food (biscuit in a park) or high-survival-value food (sandwich in the forest). In the park situation, the text described an outing to a park. In this, both the provider and the other person start out with one biscuit each for dessert. A dog takes the biscuit of the other person, who then asks the provider for some of the remaining biscuit. In the forest situation, the text described an outing in a forest. In this, both the provider and the other person start out with one sandwich each. The two become lost and are tired, hungry, and starting to be afraid. A wild dog takes the sandwich of the other person, who then asks the provider for some of the remaining sandwich.

Three scenarios were presented on a given page. These always used the same situation (low or high survival value of the food), with the provider and the recipient described successively as a same-sex sibling, a classmate, and a stranger in each of the three scenarios. At the end of each scenario were short instructions that asked how much of the resource would the provider really want to give to the recipient who was briefly but concretely described (e.g., how much of the biscuit would Julie really want to give to her sister, Marie, with whom she gets along well). This was followed by a scale ranging from 0 to 10, in increments of 1.

Booklets were constructed containing one page with three scenarios in the low-survival-value situation (biscuit in park) and one page with the high-survival-value situation (sandwich in forest). For half of these booklets, the siblings and classmates were always described as “getting along very well,” and the stranger was described as “seeming to be sympathetic.” For the other half, the siblings and classmates were described as “always being in conflict,” and the stranger was described as “not seeming to be at all sympathetic.” Female and male versions of these booklets were constructed. In the female version, the provider and the recipient were both girls. In the male version, they both were boys. Within these booklets, both the order of the low- and high-survival-value situations and the order of the sibling, classmate, and stranger scenarios were systematically varied (by inverting orders).

**Procedure**

For the high school and college participants, booklets were distributed to entire classes, with girls receiving the female version and boys receiving the male version. Participants were given as much time as they needed to answer the questions. For each of the two primary grades, booklets were distributed to the girls in the class separately from the boys (with order varied across classes). An experimenter explained each scenario in sequence (with nonparticipants given instructions to read an academic text).

**Results**

For each of the presented scenarios, participants indicated the number of pieces that a provider would really desire to give to the other. These scenarios presented providers and recipients that differed in their relationship to each other, in the quality of this relationship, and in the value of the resource. Resource value involved a comparison between sharing of a snack biscuit in a park and sharing of a sandwich when lost in a forest, which we refer to as biscuit or sandwich, respectively. Table 1 gives the mean number of expected pieces shared as a function of grade level, gender, survival value (biscuit or sandwich), type of relation (sibling, classmate, stranger), and relational quality (gets along well, does not get along well).

An initial analysis established that there was no effect of the order in which the items were presented. We then performed an analysis of
variance (ANOVA) with mean number of pieces as dependent variable; type of relation and value as repeated measures; and relational quality, grade, and gender as independent variables. This showed significant main effects for survival value, $F(1,569) = 115.22$, $p < .001$; type of relation, $F(2,568) = 380.35$, $p < .001$; gender, $F(1,569) = 5.58$, $p < .02$; and relational quality, $F(1,569) = 78.94$, $p < .001$. In addition, there were significant interactions involving Value $\times$ Gender, $F(1,569) = 9.75$, $p < .01$; Value $\times$ Grade, $F(4,569) = 4.31$, $p < .01$; Value $\times$ Relational Quality, $F(1,569) = 21.75$, $p < .001$; Value $\times$ Type of Relation,

\begin{table}[h]
\centering
\caption{Mean Number (Standard Deviation) of Pieces Shared as a Function of Grade, Gender, Value (Biscuit or Sandwich), Relational Quality (Good or Bad), and Relation to the Sharer (Stranger, Classmate, Sibling)}
\begin{tabular}{llccccc}
\hline
& & & \multicolumn{3}{c}{Biscuit} & \multicolumn{3}{c}{Sandwich} \\
Grade & Gender & Quality & $N$ & Sibling & Classmate & Stranger & Sibling & Classmate & Stranger \\
\hline
2 & Girls & Good & 17 & 4.76 & 5.18 & 1.53 & 4.24 & 4.65 & 1.82 \\
& & & & (1.89) & (1.63) & (2.03) & (1.89) & (2.18) & (2.43) \\
& Bad & 24 & 4.04 & 2.79 & 0.46 & 4.58 & 3.00 & 0.63 \\
& & & & (2.11) & (1.91) & (1.18) & (1.38) & (1.84) & (1.35) \\
& Boys & Good & 17 & 4.94 & 4.53 & 2.41 & 3.94 & 4.06 & 3.29 \\
& & & & (2.66) & (2.48) & (2.81) & (2.08) & (2.61) & (2.78) \\
& Bad & 14 & 4.07 & 2.71 & 1.07 & 5.57 & 4.00 & 1.86 \\
& & & & (2.11) & (1.91) & (1.18) & (1.38) & (1.84) & (1.35) \\
& Girls & Good & 15 & 5.13 & 5.13 & 2.07 & 5.07 & 5.07 & 2.67 \\
& & & & (2.17) & (1.36) & (1.62) & (0.26) & (1.22) & (1.72) \\
& Bad & 26 & 4.08 & 4.08 & 2.35 & 4.77 & 4.42 & 2.73 \\
& & & & (2.26) & (1.72) & (2.42) & (2.05) & (1.84) & (2.41) \\
& Boys & Good & 10 & 4.3 & 4.60 & 1.90 & 5.20 & 4.80 & 3.00 \\
& & & & (1.49) & (2.26) & (1.73) & (0.42) & (0.63) & (2.45) \\
& Bad & 15 & 3.27 & 2.67 & 2.47 & 3.73 & 3.87 & 2.87 \\
& & & & (1.67) & (1.76) & (3.02) & (1.58) & (1.55) & (2.72) \\
5 & Girls & Good & 15 & 5.13 & 5.13 & 2.07 & 5.07 & 5.07 & 2.67 \\
& & & & (2.17) & (1.36) & (1.62) & (0.26) & (1.22) & (1.72) \\
& Bad & 26 & 4.08 & 4.08 & 2.35 & 4.77 & 4.42 & 2.73 \\
& & & & (2.26) & (1.72) & (2.42) & (2.05) & (1.84) & (2.41) \\
& Boys & Good & 10 & 4.3 & 4.60 & 1.90 & 5.20 & 4.80 & 3.00 \\
& & & & (1.49) & (2.26) & (1.73) & (0.42) & (0.63) & (2.45) \\
& Bad & 15 & 3.27 & 2.67 & 2.47 & 3.73 & 3.87 & 2.87 \\
& & & & (1.67) & (1.76) & (3.02) & (1.58) & (1.55) & (2.72) \\
7/8 & Girls & Good & 37 & 5.03 & 4.24 & 2.14 & 5.02 & 4.73 & 2.57 \\
& & & & (1.48) & (1.62) & (1.72) & (1.61) & (1.50) & (1.61) \\
& Bad & 30 & 4.10 & 2.47 & 1.13 & 4.77 & 2.97 & 2.00 \\
& & & & (2.02) & (1.81) & (1.28) & (1.94) & (1.73) & (2.03) \\
& Boys & Good & 34 & 4.82 & 4.18 & 1.97 & 5.26 & 4.50 & 2.67 \\
& & & & (1.93) & (1.45) & (1.47) & (1.93) & (1.67) & (1.74) \\
& Bad & 40 & 3.73 & 1.58 & 1.03 & 4.43 & 2.60 & 1.78 \\
& & & & (2.88) & (1.65) & (1.77) & (2.45) & (1.95) & (2.29) \\
10/11 & Girls & Good & 26 & 4.77 & 4.46 & 1.92 & 5.08 & 4.69 & 2.54 \\
& & & & (1.58) & (1.03) & (1.60) & (1.29) & (0.79) & (1.50) \\
& Bad & 28 & 4.71 & 2.50 & 1.25 & 5.14 & 4.03 & 2.54 \\
& & & & (1.33) & (2.01) & (1.69) & (0.97) & (1.79) & (1.77) \\
& Boys & Good & 47 & 4.45 & 3.68 & 1.74 & 5.09 & 4.60 & 2.96 \\
& & & & (2.43) & (1.87) & (1.99) & (2.00) & (1.84) & (1.72) \\
& Bad & 41 & 3.10 & 1.32 & 1.00 & 4.27 & 2.76 & 2.10 \\
& & & & (2.06) & (1.65) & (2.00) & (1.82) & (1.77) & (2.02) \\
University & Girls & Good & 49 & 4.94 & 4.71 & 3.00 & 4.94 & 4.69 & 3.55 \\
& & & & (0.85) & (0.79) & (1.59) & (0.77) & (0.77) & (1.39) \\
& Bad & 43 & 3.88 & 2.47 & 1.14 & 4.70 & 3.86 & 2.30 \\
& & & & (1.72) & (1.92) & (1.52) & (1.32) & (1.54) & (1.58) \\
& Boys & Good & 33 & 4.73 & 4.06 & 1.36 & 4.97 & 4.67 & 2.97 \\
& & & & (1.38) & (1.32) & (1.52) & (0.53) & (0.85) & (1.76) \\
& Bad & 43 & 2.86 & 1.77 & 0.81 & 4.28 & 3.35 & 1.91 \\
& & & & (2.04) & (1.72) & (1.48) & (1.12) & (1.51) & (2.86) \\
\hline
\end{tabular}
\end{table}

Note. Maximum number per cell is 10.
$F(2,568) = 5.66, p < .01$; Type of Relation $\times$ Gender, $F(2,568) = 6.46, p < .01$; Type of Relation $\times$ Grade, $F(2,568) = 5.19, p < .001$; Type of Relation $\times$ Relational Quality, $F(2,568) = 38.98, p < .001$; and Value $\times$ Type of Relation $\times$ Relational Quality, $F(2,568) = 13.58, p < .001$. All post hoc comparisons were done using the Tukey test.

Analysis of the main effects of the three contextual variables showed that sharing was expected to be greater between siblings ($M = 4.50, SD = 1.67$) than between classmates ($M = 3.64, SD = 1.70$) and greater between classmates than between strangers ($M = 2.03, SD = 1.73$). Furthermore, sharing was expected to be greater when social partners relate well ($M = 3.95, SD = 1.15$) than when they do not ($M = 2.87, SD = 1.32$). Third, sharing was expected to be greater when the survival value is higher ($M = 3.73, SD = 1.43$) than when it is lower ($M = 3.04, SD = 1.58$).

The pattern of interactions indicates that expectations of sharing are more complex than can be explained by simple combinations of these main effects. Expected sharing between strangers is generally low, and expected sharing is less with less sympathetic strangers ($M = 1.62, SD = 1.73$) than with more sympathetic strangers ($M = 2.47, SD = 1.64$). Particularly interesting is the pattern of variation with siblings and classmates. When quality of the relation is good, expected sharing between siblings ($M = 4.87, SD = 1.47$) and between classmates ($M = 4.50, SD = 1.27$) was similar, although the difference was statistically significant. When the relation is bad, the difference between siblings ($M = 4.15, SD = 1.76$) and classmates ($M = 2.84, SD = 1.67$) became much greater. This means that quality of relation has a greater relative impact on classmates than on siblings. One descriptive way of looking at this is to calculate the relative decrease in expected sharing for siblings and for classmates when the relationship is described as bad versus good. The relative decrease for siblings is 14.8%, whereas for classmates the relative decrease is 36.9%. It is interesting that the relative decrease for strangers is 34.4%. Thus, although quality of the relationship has a consistent effect on expected sharing, its relative effects are less for siblings than for classmates (and strangers).

A similar pattern emerges when the interaction between the survival value of the resource and quality of relation was examined. When relational quality is good, expected sharing for the high-survival-value sandwich ($M = 4.15, SD = 1.24$) was greater than expected sharing for the low-survival-value biscuit ($M = 3.74, SD = 1.31$). When relational quality is bad, expected sharing for the sandwich ($M = 3.34, SD = 1.49$) was also greater than expected sharing for the biscuit ($M = 2.39, SD = 1.54$). However, the relative decrease in expected sharing between good and bad relational quality was greater for the low-survival-value biscuit (36.1%) than for the high-survival-value sandwich (19.5%). With the addition of the basic limit of sharing in these situations to one half of the resource, these two basic patterns can explain most of the more complex interactions among these three variables.

This analysis clearly shows that the statistical complexity of the results corresponds to meaningful interactions for these three factors. Specifically, the effects of relational quality are modulated by both the type of relation and value of the resource. In both cases, it the relative effects of relational quality are decreased when the importance of either the relation or the resource is greater.

**Gender-Related Differences**

We then examined the way girls and boys differed in their expectations of sharing (this refers to girls’ expectations of sharing between girls and boys’ expectations of sharing between boys). Overall, girls expected a higher level of desire to share ($M = 3.58, SD = 1.22$) than did boys, ($M = 3.19, SD = 1.45$). We then looked at the Type of Relation $\times$ Gender interaction. This showed that, in the case of siblings, there was no significant difference between girls’ expected sharing ($M = 4.69, SD = 1.39$) and boys’ expected sharing ($M = 4.31, SD = 1.88$). In the case of strangers, there was also no significant difference between girls’ expected sharing ($M = 2.11, SD = 1.68$) and boys’ expected sharing ($M = 1.95, SD = 1.79$). However, girls expected a higher level of sharing among classmates ($M = 3.95, SD = 1.56$) than did boys ($M = 3.33, SD = 1.79$). We then looked at how girls and boys differed in expectations as a function of resource value. The difference between girls’ expectations for sharing the high-value sandwich ($M = 3.83, SD = 1.27$) was not significantly different from boys’ expectations ($M = 3.64, SD = 1.57$). However, girls expected greater sharing of the low-value biscuit ($M = 3.33, SD = 1.42$) than did boys ($M = 2.75, SD = 1.68$).

Once again, the statistical interactions can be understood in a meaningful way. Boys and girls expected generally similar levels of sharing when the relation or the resource is very important. However, when this is not the case, the relative decrease in expected sharing was greater for boys than for girls.
Developmental Patterns

The preceding analyses looked at interactional patterns that were valid across all age levels combined. However, it is important to look in more detail at the way that these patterns varied by age. We first looked at the question of whether there is any evidence that younger children’s internal models are less complex than those of older participants. The statistical analysis that was used previously is not appropriate for this kind of analysis because it is possible that differences in a given age group might be statistically masked in a global analysis. Specifically, we were looking to see whether younger children’s expectations of sharing are determined by less complex interactions among factors than are older participants’ expectations. The clearest way to examine this question is to consider the youngest children separately.

We performed an ANOVA using only the Grade 2 children’s expectations of sharing. This analysis indicated significant main effects of type of relation, $F(2,66) = 44.88$, $p < .001$, and significant interactions involving Value x Quality of Relation, $F(1,67) = 5.24$, $p < .05$; Type of Relation x Quality of Relation, $F(2,66) = 6.70$, $p < .01$; and Value x Type of Relation x Quality of Relation, $F(2,66) = 5.00$, $p < .01$.

This analysis first showed that these children’s expectations of sharing were sensitive to the three basic contextual variables examined here: type of relation, survival value, and quality of the relation. As was the case for the analysis that included all participants, there was a three-way interaction among these factors, which can be best explained by looking at the separate two-way interactions. Analysis of the two-way interaction involving quality of relation and type of relation showed that there was no difference in expected sharing among siblings having good ($M = 4.47$, $SD = 1.74$) or bad relations ($M = 4.5$, $SD = 1.94$), but that there was a significant difference between classmates having good ($M = 4.60$, $SD = 1.69$) or bad relations ($M = 3.07$, $SD = 1.92$), and between strangers described as sympathetic ($M = 2.26$, $SD = 2.43$) and not sympathetic ($M = .88$, $SD = 1.49$). Analysis of the two-way interaction involving quality of relation and the value of the resource showed that there was no difference in expected sharing among siblings having good ($M = 3.89$, $SD = 1.57$) when the relation is good, but that there was a significant difference between the sandwich ($M = 3.13$, $SD = 1.58$) and the biscuit ($M = 2.50$, $SD = 1.59$) when the relation is bad. In both cases, the effect of quality of relation is modulated according to the relative importance of the type of relation and resource value. Although the details of these interactions differ from those found on the global analysis, the basic interactional pattern is similar.

It is clear that Grade 2 children’s expectations reflect consistent, complex patterns of interactions involving the three basic contextual factors—quality of relation, type of relation, and value of resource—that are no less complex than those of older participants. There is thus no clear evidence of any age-related difficulty in using multiple factors to generate different expectations with the method used in this study.

Our viewpoint claimed that one process that might underlie at least part of developmental change is consolidation. One way of examining this question is to examine the consistency of individual response patterns with the most commonly observed patterns. Each participant was asked to make six predictions. Response patterns can be generated by summing across conditions. For example, we can determine the overall pattern of relations between siblings and classmates by averaging predictions made on the sandwich and biscuit situations. We can then determine whether these patterns that characterize an individual’s responses differ from the most commonly observed patterns. A consolidation hypothesis claims that increasing experience allows children and adolescents to observe a greater variety of interactions that would, on average, tend to overlap more with the observations of their peers. It was thus predicted that the percentage of overall response consistency, as measured by the proportion of individual patterns that were the same as one of the most commonly produced patterns, should increase with age.

Given the design of this study, it was only possible to look at two key patterns. Specifically, we looked at (a) individual patterns in the distinction among siblings, classmates and strangers, and (b) individual patterns in the distinction between the two resources (sandwich, biscuit). We first examined the major patterns that were most commonly used to distinguish sharing among siblings, classmates, and strangers. There were four such patterns. The most important of these was the pattern in which expected sharing was greater between siblings than between classmates, and the latter was greater than that between strangers (which accounted for 45.3% of overall responses). The second pattern indicated equal sharing between siblings and classmates and less sharing between strangers (22.2% of overall responses). The third most common pattern was equal sharing with all three relational types (8.1% of
The fourth most common pattern was greatest sharing between siblings and less, but equal sharing between classmates and strangers (6.1% of overall responses). Overall, these four patterns accounted for 81.8% of total responses. We then examined response patterns that compared sharing of the low-value biscuit with sharing of the high-value sandwich. The two most frequent patterns were greater sharing with the sandwich (58.2%) and equal sharing (25.1%).

To provide a more reliable and synthetic analysis, we grouped together the two primary grades and the two secondary grades. We then calculated the percentage of participants at the three levels (primary, secondary, university) whose individual response patterns were the same as one of the most frequently observed patterns, for both type of relation and resource value. For the type of relation, we performed a log linear analysis with the presence of one of the common patterns as the dependent variable and grade level as the independent variable. This indicated a significant effect of grade level, \( \chi^2(2) = 37.94, p < .001 \). Individual chi-square analyses showed that the percentage of consistent patterns was greater at the secondary level (\( M = 82.0, SD = 38.5 \)) than at the primary level (\( M = 65.2, SD = 47.8 \)), and it was greater at the university level (\( M = 95.2, SD = 21.4 \)) than at the secondary level. We then performed the same analysis for resource value. This also indicated a significant effect of grade level, \( \chi^2(2) = 19.22, p < .001 \). Individual chi-square analyses showed there was a significantly greater percentage of consistent patterns at the secondary level (\( M = 86.2, SD = 34.5 \)) than at the primary level (\( M = 71.0, SD = 45.5 \)), but no difference between the second level and university (\( M = 88.7, SD = 31.8 \)).

In addition, we calculated the probability of producing at least one of the most common response patterns randomly. Observed proportions were significantly greater than chance for all grade levels.

Analysis of response patterns is thus consistent with the idea that one of the processes that underlie developmental change is the gradual consolidation of models. There are, however, some developmental differences that are indicated by the global statistical analysis initially presented. This analysis indicated significant interactions between resource value and grade, and between type of relation and grade. Post hoc analyses showed that there are significant differences between the high-value resource (sandwich) and the low-value resource (biscuit) at all grade levels except for the youngest (Grade 2) participants. In addition, there are significant differences in expected sharing between siblings and classmates at all grade levels except for Grade 5 participants. These differences reflect specific developmental differences in expectations that are not directly related to the degree of consolidation.

**Consistency With Empirical Data**

A final question concerns the accuracy of the pattern of expectations that were observed. If internal models are constructed on the basis of observed behavior, one would expect that they would reflect what is known about sharing behavior. As stated in the introduction, empirical studies allowed the conclusion that (a) there is more sharing between relatives than between nonrelatives (Loh & Elliott, 1998; Ma & Leung, 1993), (b) there is more sharing between social partners with good relations than bad relations (Ma & Leung, 1993), and (c) there is a mixed set of results that are consistent with more sharing between girls than between boys (e.g., Jha et al., 1998; Zarbatany et al., 1985). The global patterns of expectations found in this study are consistent with these results, especially for older participants. In fact, the gender differences in expectations that were observed show increased sharing only in low-value contexts but not in high-value contexts. Thus, these results accurately mirror the mixed pattern of results obtained in the cited studies. In other words, with the method used here, the combined expectations of our participants appear to be accurate in predicting actual behavior.

**Discussion**

The results of this study are consistent with the hypothesis that both children and adolescents have internal models of food-sharing behavior that involve evaluation of some key contextual factors. The factors we examined were derived from analyses of food sharing in traditional cultures (e.g., Hill, 2002) that are considered basic aspects of human lives. Specifically, we examined expectations of sharing as a function of differences in the nature of the relationship between social partners, the quality of the relationship, and the survival value of the resource to be shared. As expected, even the youngest (Grade 2) participants showed expectations of food-sharing behavior that are clearly modulated by all of these contextual factors. In addition, the patterns of expectations at all ages showed complex, but meaningful, interactions among these factors. These patterns cannot be described as simple linear combinations of the individual factors, but involve the kinds of complex factors. 

...
modulation that characterize conditional strategies in many nonhuman animals (e.g., Kramer, 2001).

Although many of the basic patterns are similar, there are some key gender differences in expectations of sharing. Specifically, although boys and girls had similar expectations of sharing between siblings and sharing with the high-survival-value resource, boys’ expectations of sharing were less than girls’ when this was not the case. This result is consistent with the mixed pattern of empirical results concerning overall differences in sharing behaviors between girls and boys because they imply that these differences are not global but are limited to particular kinds of contexts. In addition, these results are consistent with previous results (Markovits et al., 2001) that indicate that boys and girls have differing internal models of social interactions.

We can summarize the overall results of this study into an algorithm that describes the main patterns of expectations. Before doing so, it is useful to state some limitations of this algorithm. First, the overall means for sharing generally do not go much over half of the available resources in these situations. This would probably not be the case if other factors were varied, for example, if the provider were described as less hungry or in better shape than the person requesting food. In addition, there are many potential factors that have not been examined here that might also have effects (e.g., sharing with opposite-sex peers, with older or younger children or adults, etc.). Within these constraints, the following forms of variation can be described:

1. If the survival value of the resource is more critical, expected sharing increases and the effects of other factors decrease.
2. If there is a family relationship, expected sharing increases maximally and the effects of other factors decrease.
3. If there is not a family relationship, expected sharing varies according to the probability that the provider and recipient will subsequently interact.
4. Expected sharing increases if the provider and the recipient can be expected to interact positively in the future.

Within this basic algorithm, we can include gender differences:

1. The relative effects of decreases in resource value or lack of a family relationship are greater on boys’ expectations of sharing between boys than on girls’ expectations of sharing between girls.

The preceding algorithm describes the key patterns that most accurately characterize the older participants in this study.

Another important question that was addressed in this study was the nature of developmental change in internal models of sharing. Our analysis of developmental patterns is consistent with the view that internal models do not require the kind of explicit coordination of factors that characterizes explicit logical or social thinking. Even the youngest participants in this study made judgments that varied systematically along several dimensions in ways that were similar to global patterns of variation.

Observed developmental differences were of two kinds. First, there were specific differences that could well reflect the presence of differential patterns of social interactions at specific age levels. For example, participants at all ages expected greater overall sharing between siblings than between classmates, with the exception of Grade 5 children. It is also around this age that interactions with peers become much more frequent and that the nature of peer interactions change (Brown, 1990; Cairns & Cairns, 1994). The observed difference in expectations is consistent with the behavioral evidence that suggests that the relative importance of peers increases in a marked way in preadolescence. Another example of this kind of developmental change was the relatively small difference in expectations of sharing between the high- and low-survival-value resource observed in the youngest children. This could reflect both the relative security of the mainly middle-class environments of our participants and the relative lack of experience of the younger children. Although speculative, it is interesting that this suggests that younger children from more deprived environments should modulate their expectations of sharing by considering the relative importance of resource value at an earlier age than those from richer environments.

The second kind of developmental pattern was a clear trend toward increased internal consistency between individual patterns of responses and global patterns. This did not mean that the individual models of older participants were the same but rather that these varied within a smaller range of possibilities than was observed with the younger children. This latter result supports the idea that internal models tend to become more consistent over time, as individual children and adolescents acquire a larger, and generally more overlapping, database of experience. In other words, these results indicate that there is a general pattern of consolidation due to increasingly varied experience with age.
These models are also consistent with empirical data about sharing behavior. This adds to evidence from previous studies (Markovits et al., 2001; Markovits & Dumas, 1999) that have found a good correspondence between internal models and empirical data about the way social interactions are organized. Although more evidence from a wider range of social interactions is required to allow a firmer conclusion, the present results add weight to the idea that children are efficient processors of social information and that they are able to reconstitute complex patterns of behavior into internal representations.

Finally, although the link between internal representations and behavior remains unclear, the existence of consistent internal models provides a useful hypothesis for explaining the difficulty in establishing clear relations between explicitly stated and consciously accessible goals or values and real-life behavior. The sheer complexity of social interactions makes it reasonable to assume that much behavior is performed under circumstances that do not allow a high degree of conscious processing (e.g., Bargh & Ferguson, 2000). Behavior is likely mediated by expectations that are stored in implicit internal models, which may not reflect consciously held values or rules. Research is needed to examine the relation between the acquisition of a novel behavior, conscious explanation of this behavior, and implicit rules that guide future enactment of the behavior.

References


Appendix

Examples of Drawings and Texts Used in the Sharing Situations

Situation 1: Biscuit in park


Julie and her sister Manon are always fighting. One day, they went to the park. Their mother gave them each a biscuit for a snack. But, as soon as they got to the park, a dog ran off with Manon’s biscuit. Manon asked Julie for some of her biscuit.

Situation 2: Sandwich in forest

Denis and his brother Sebastien get along very well. One day, they went far into the forest, where they became lost. They were very hungry and were starting to be scared. All they had to eat was a sandwich each. But a wild dog ran off with Sebastien’s sandwich. Sebastien asked Denis for some of his sandwich.