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Chapter 12

Cognitive and social cognitive development: Dual-process research and theory

Paul A. Klaczynski

The scant attention cognitive and social psychologists pay to developmental research is both confusing and disconcerting. For far too long, it has long appeared as though theorists believe that research involving 18-year-old college students is sufficient to understand the myriad intricacies and variations of thought. I note here but four of the many reasons for considering more seriously developmental findings and using these to construct more encompassing theories of cognition and social cognition than currently exist.

First, the past decade has witnessed an increase in attempts to integrate dual-process theories with evolutionary approaches to cognition (Evans 2008; Toates 2004). Because the age at which different evolved psychological processes express themselves varies, development may be a particularly fertile testing ground for dual-process theories and, in particular, the widespread assumption that various domain-specific implicit processing systems emerge (phylogenetically) prior to an explicit, higher-order processing system. Second, dual-process theorists assume that implicit and explicit processing systems are generally independent. Research has yet to address such issues as, if both types of processing are present at birth, do they become increasing independent with age? If we are born with only implicit processing systems, how does an explicit system emerge and does it originate in one or more implicit processing systems (see Karmiloff-smith 1992)? Third, cognitive neuroscientists have identified distinct areas of the brain associated with implicit and explicit processing. Claims that these areas do, in fact, underlie different processing systems would be strengthened if, for example, the maturation of these areas (e.g. prefrontal cortex) paralleled age changes in different processing systems.

Finally, insights into the reasoning of purportedly mature thinkers can be gained by examining the antecedents of adults' response failures on 'heuristics and biases' tasks. Although many of the biases observed in adults have been explored in children, this research has been referenced infrequently in the adult literature. Perhaps one reason for neglecting developmental research is the implicit assumption that, if adults perform poorly on reasoning and decision making tasks, children's performance must be even worse. It may therefore come as a surprise that children sometimes make

better decisions and *less* biased judgments, and thus may (sometimes) be more rational, than adults.

In this chapter, I describe some of these counterintuitive age trends, present a developmental dual-process theory that affords a more parsimonious interpretation of these trends than offered by traditional theories of development, and survey a research program intended to test developmental predictions derived from dual-process theories. I begin by outlining evidence that contravenes traditional, unidirectional theories of development and then present an amended version of the developmental dual-process theory I have advocated in recent years. Next, I present research that has upheld several dual-process predictions, challenges black-and-white conceptions of rationality, and supports the 'levels of rationality' approach advocated by Reyna and her colleagues (Reyna and Farley 2006; Reyna et al. 2003). I conclude by discussing briefly some theoretical and methodological shortcomings of developmental dual-process theories.

Through most of this chapter, I refer to two forms of processing, 'experiential' (Epstein 1994) and 'analytic' (Evans 1989) processing. In part, I use the experiential/analytic distinction because it better reflects what the two systems do and how they operate than implicit/explicit distinctions, the System 1/System 2 distinction (Stanovich 1999), or other distinctions made in cognitive and social psychology (see Evans 2008). In addition, neither 'implicit processing' nor 'System 1 processing' refers to a single processing system. Rather, it is now clear that there exist multiple types (implicit memory, associative learning, etc.) of managing input and output preconsciously (Evans 2008, this volume; Stanovich, this volume). In the term 'experiential processing', my intent (usually) is to implicate *acquired* automatically-activated heuristics, biases, and beliefs. Thus, my focus is on the automatic operation and development of a particular system, with the caveats that (a) humans are likely biologically predisposed to acquire some systems more rapidly than others (Hejmadi et al. 2004), (a) there are multiple implicit systems (Stanovich 2004, this volume), (c) information is likely fed into the experiential system through an explicit, analytic processing system *and* from other implicit processing systems (e.g. associative learning, perceptual processing), and (d) to varying degrees, experiential output affects other processing systems.

In part because explicit cognition has been the almost exclusive focus of post-infancy research, development is often construed as a unidirectional process, proceeding from relatively immature cognition to relatively mature cognition. However, satisfactory accounts of intellectual growth must explain observations that within-child variability is the norm in cognitive and social cognitive development and inverse relationships between age and performance on various logic and judgment problems. Traditional, unidirectional theories cannot explain counterintuitive age trends on various cognitive and social cognitive tasks or, more specifically, indications of two developmental trends on superficially different, but logically-isomorphic, tasks. Whereas most evidence indicates age increases in normative responses, age is also associated with increases in non-normative responses and violations of formal rules of inference. Neither the coexistence of these age trends nor the fact that these trends are generally statistically independent has found an adequate explanation in conceptualizations of development that focus on explicit cognition.

A developmental dual-process theory

Dual-process theorists have argued that information processing involves simultaneous operations in both experiential and analytic processing. Motivations, beliefs, intellectual dispositions, task features, and situational characteristics (e.g. time constraints) collude to determine which system is *predominant* at a particular moment. When analytic processing predominates, adult thinking often (but not necessarily; see Evans 2008) involves attempts to decontextualize structure from potentially misleading contents and base subsequent inferences, judgments, and decisions on the resultant representation. This computationally burdensome processing more often results in normative responses than when the faster and more cognitively-economical experiential system predominates. However, considerable care should be exercised to avoid equating normative responses with analytic predominance and non-normative responses with experiential predominance (see Evans, this volume; Evans and Over 1996; Klaczynski 2001a; Stanovich, this volume). This precautionary note is particularly important in reviewing developmental research. For instance, developmental differences in non-normative responses may arise from age differences in reliance on experiential processing and/or because younger children have not acquired the same analytic competencies as older children.

Because it likely evolved before the analytic system and expends few cognitive resources, experiential processing predominates most everyday cognitive activity (Evans 2006; Stanovich 1999; see also Reyna and Brainerd 1995). Experiential processing facilitates information mapping onto and assimilation into existing knowledge categories and the conversion of conscious strategies into automatic procedures. Experience predominance automatically cues contextualized task representations which, in turn, activate heuristics and other memories (e.g. procedural, vivid episodic memories) that can serve as the basis for inferences and judgments. The heuristics and other memories activated in the course of experiential processing are acquired through both implicit and explicit processing of experiences; the gist abstracted from experiences often forms serves as the basis for the development of explicit, relatively algorithmic strategies and heuristics. With age, as memories accrue and as conscious strategies are transformed into automatic procedures, repertoires of heuristics become more diverse and more easily activated.

This simple formulation may appear to imply adults rely on heuristics more than children; this is *not*, however, the case. Instead, when experiential processing is predominant, adults' judgments and decisions should reflect more variability in the types of heuristics they use. Although the availability of an increasingly diverse repertoire of heuristics is almost certainly one of the reasons that adults *sometimes* rely more heavily on heuristics than children, access to and activation of this repertoire must be distinguished from its utilization. Thus, an important characteristic of development is an increase in the numbers and types of environments that automatically *activate* heuristics and other procedural memories. However, as discussed subsequently, activation is a necessary but not sufficient condition for utilization.

Developments in experiential processing are accompanied by developments in the analytic processing system. The analytic processing system comprises the

consciously-controlled, effortful thinking that enable activation of competencies traditionally considered essential to cognitive development and normative decision making. Unlike experiential processing, analytic processing involves deliberative analysis of task requirements and, under some conditions, the context in which the task is embedded. The representations arising from this reflective processing are then used to draw conclusions, judgments, decisions, and arguments. Unlike experiential processing, analytic processing *may* involve decoupling structure from content, although contexualized representations involving, for instance, coordinating of task requirements with pragmatic considerations, may also be subjected to conscious deliberations. Indeed, as Buchtel and Norenzayan (this volume; also Luria 1976) discuss, the decontextualization of logical structure from context may be a peculiarly Western emphasis, given that adults in Eastern societies rely more on holistic, contextualized representations. Such broad culture differences lead to interesting questions about the development, culture, and representation nexus; for example, early in the development of analytic thought, are children across cultures more similar in their dispositions toward contextualization/decontextualization than later in development, after exposure to different beliefs systems and forms of socialization?

Analytic competencies, such as inductive and deductive reasoning abilities and the metacognitive and executive abilities required for decontextualization and for determining whether decontextualized or contextualized representations are more appropriate in a given situation, do not develop in an all-or-none fashion. Rather, different abilities are acquired at different points in development and at different rates for different children, varying as a function of experiences, culture, biological maturation, and genetic endowments. Regardless, after these abilities have been acquired, their use of often highly effortful, particularly in the early phases of acquisition. Given that, in many everyday circumstances, humans gravitate toward cognitively— and physically—economical strategies, developments in analytic competencies must be accompanied by developments in tendencies to consciously utilize these competences. In other words, the 'mere' acquisition of the *abilities* to inhibit memory-based interference, reflect on one's reasoning, evaluate the quality of decision options, etc., guarantees neither that adolescents and adults *perform* at higher levels than children nor that relatively mature reasoners will opt for the utilization of those competencies they possess. For the latter of occur, developments at the intentional level of analysis are critical (see Stanovich and West 1998, 2000; Stanovich 1999, this volume); specifically, competence development must also include the acquisition of *dispositions* to be cognitive engaged, control impulsive actions, and determine whether to rely on contextualized or decontextualized representations.

Thus, development is marked by, but is not limited to, the acquisition of stereotypes, biases, and heuristics, increases in processing speed and working memory capacity, progressions in computational and reflective thinking abilities, metacognitive skills, and thinking dispositions. Heuristics are used not only because they are 'fast and frugal' (Gigerenzer 1996), intuitive appealing, and activated automatically, but also because they are often harmless and sometimes beneficial. Heuristics can be extremely useful, as is often the case with experts (Reyna and Farley 2006) or disadvantageous, to the self and/or the larger community. Reasoners often have a fleeting awareness

that heuristics and other biasing tendencies have been activated, often in the form of the intuitions or 'gut' feelings that they are 'right' (for discussion of 'feelings of rightness' and how these feelings relate metacognition, see Thompson, this volume). In other words, although activation is automatic, at least some heuristics are momentarily available in working memory. This availability affords reasoners the opportunity to reflect on the value of a heuristic, decide upon its use, and, if it is judged inadequate, instead utilize an analytically-derived strategy—a process referred to as 'metacognitive intercession' (Klaczynski 2005; Klaczynski and Cottrell 2004). Even during adulthood, most people do not engage in this type of conscious reflection. However, the occurrence of such reflective analyses illustrates a basic tenet of dual-process theories: When the experiential system is predominant, the analytic system is active, but subordinate.

Interceding in experiential processing likely requires advanced metacognitive abilities and dispositions (Stanovich 1999) and is therefore achieved more effectively by adolescents and adults than children. Most adolescents and adults are not disposed to metacognitively intercede, although individual differences in intercession tendencies do exist (Klaczynski and Fauth 1997). Unfortunately, the distinction between metacognitive competencies and metacognitive dispositions is often blurred. The former involve the abilities to: Reflect on how one knows, evaluate the accuracy of one's knowledge, monitor reasoning for consistency and quality, and plan/select situationally-appropriate strategies. Dispositions are motivational in nature, and reflect beliefs in the value of engaging in effortful analysis. Thus, for instance, among adolescents with nearly identical metacognitive abilities, and who are therefore equally able to inhibit experientially-activated representations and the responses these representations cues, there generally exist large individual differences in the dispositions that motivate metacognitive intercession (Klaczynski 2005).

Empirical support for developmental dual-process theories

With the exception of fuzzy-trace theorists (see Reyna and Brainerd 1995), developmental psychology has lagged behind other areas of psychology (e.g. social, cognitive, clinical) not only in examining predictions based on dual/multiple-process theories but also in refining theoretical descriptions of different processing systems and how these systems change over time. However, a variety of research has been conducted on age trends in memory, judgments and decisions, reasoning, motivated reasoning, stereotypes, and magical thinking. On the one hand, none of this research, examined individually, establishes definitively either the existence or development of two (or more) operating systems. On the other hand, as a whole, an impressive evidential corpus provides compelling reasons for adopting, and further developing, a comprehensive dual-process theory of development.

Memory

Like adults, children sometimes remember information without conscious awareness that they are remembering: Presented incomplete items early in an experiment, children later identify the complete items more quickly and accurately than

non-primed items—despite being unaware that they had previously examined the primed items (Hayes and Hennessy 1996; see also Bargh and Chartland 1999). Other evidence similarly suggests that implicit and explicit memory cannot be explained by the same operating system. Newcombe (Lie and Newcombe 1999; Newcombe and Fox 1994), for example, found that few 9–10 year olds accurately recognized preschool classmates. Skin conductance reactivity, used to index implicit memory, was greater for actual classmates than false classmates. In parallel with research on normative and non-normative responses to judgment and reasoning tasks, explicit recognition was unrelated to implicit memory. This independence, findings of few or no age increases in the implicit memory, data linking implicit and explicit memory to different brain systems (Ullman 2004), and clear age increases in the explicit memory (Schneider and Bjorklund 1998) are best explained by dual-process theories. Fuzzy-trace theorists in particular have compiled an impressive set of data, utilizing a variety of methodological paradigms and examining numerous aspects of memory (e.g. the memory-reasoning dissociation, eyewitness memory), that can apparently only be explained by assuming that development occurs in two independent systems.

According to fuzzy-trace theory (Brainerd and Reyna 2001; Reyna and Brainerd 1995), parallel processing allows experiences to be encoded at multiple levels and memories are encoded as both verbatim and gist traces. Verbatim traces of details represent experiences which, in turn, are more likely than gist traces to be governed by conscious attempts to encode and remember. Gist traces are holistic abstractions, imprecise representations of the meaning of experiences, which can serve as prototypes for general categories of events, people, or objects (Reyna and Farley 2006). Development is characterized by increased reliance on gist representations. This verbatim-gist shift has a clear adaptive value: compared with verbatim traces, gist traces are less susceptible to interference and forgetting, are more cognitively economical and, in part because they are less cognitively burdensome, lend themselves more easily to higher-order cognitive operations (Reyna and Brainerd 1995).

A critical finding from fuzzy-trace research is that verbatim memory and reasoning are sometimes independent. This finding contravenes the common assumptions that (a) memory is primarily reconstructive and, therefore, that reasoning is the primary source of memory and (b) memory is necessary for reasoning. For instance, Brainerd and Kingma (1985) showed that memory for premise information on numerous tasks (e.g. transitive inference, class inclusion) and reasoning on those tasks were independent. Thus, verbatim memory for quantitative information does not predict transitive inferences (A > B; B > C; therefore, A > C) or inclusion errors; thus, from four dogs, five horses, and 11 cows, verbatim memory for each category is unrelated to the faulty inference that cows outnumber animals. Such inclusion errors ($p[A_1] > p[A_{1\text{-}n}]$) are structurally similar to the conjunction fallacy ($p[AB] > p[A]$) in adult decision making (Reyna 1991). In each case, the probability of a subcategory is inferred to be greater than the probability of the more inclusive category.

Consistent with other dual-process theories, in fuzzy-trace theory, such evidence has been taken to indicate that operations on task structures depend on representations dissociated from the processes responsible for encoding surface-level information. As a result of this dissociation, reasoning becomes increasingly dependent on

gist abstraction (similar to, but not identical with, decontextualization) and operates independently from verbatim memory. Together with research described earlier, the independent operations of reasoning and verbatim memory necessitate conceptualizations of development that emphasize parallel processing at the conscious and preconscious levels and different developmental trajectories for inferences that arise from conscious, deep processing and those that arise from preconscious processing.

Decision making

Two general trends have been evident in developmental research on decision making. A first focus has been on the construction of measures of competent decision making and the relationship of scores on these assessments to adolescent judgments of risk (e.g. Parker and Fischhoff 2005). A second trend has focused on the roles of experience and social factors (e.g. peers) on adolescents' decisions and risk assessments and the correlations of these judgments to measures of psychosocial maturity (e.g. self-reported impulse control) and intellectual ability (see Steinberg 2004). These trends have in common the assumptions that adaptive decisions are made explicitly and maladaptive decisions are made with little conscious reflection. In assuming that explicit processes (e.g. deliberate calibration of risks against base rates) are the principle means of making adaptive decisions, the possibility that experiential processing sometimes results in better decisions and risk assessments than analytic processing has not been addressed.

As an example, adolescents often believe that they are less vulnerable to risks than their peers; these invulnerability perceptions increase from adolescence into early adulthood. Even so, adolescents typically overestimate the base rates of deleterious consequences of such behaviors as smoking, drunk driving, and unprotected sex (Millstein and Halpern-Felsher 2002). One explanation for risk overestimation assumes age increases in exposure to messages regarding consequences and 'knowledge' (real and assumed) of peers who experienced these consequences (see Jacobs et al. 1995). This knowledge, preserved as gist, may lead to age increases in reliance on availability. Availability, as opposed to risk calculation based on actual base rates, may trigger 'feelings of wrongness' and thus may serve the adaptive function of inhibiting impulses to engage in risky behaviors.

Similar counterintuitive age trends in judgments and decisions have been reported on various heuristics and biases tasks. For instance, Jacobs and Potenza (1991) found that reliance on statistical evidence on asocial decision tasks (e.g. about bicycles) increased from first grade through adulthood. On logically-isomorphic social problems (e.g. about cheerleaders), the opposite trend was observed: With increasing age, children relied more on the 'representativeness heuristic' and less on statistical evidence. Davidson (1995) similarly reported that, when task contents activated stereotypes of the elderly, older children committed the conjunction fallacy more than younger children—a finding also attributed to increased reliance on representativeness. Developmental increases have also been reported for framing effects (Reyna and Ellis 1994), ignoring denominators on ratio problems (Brainerd 1981),

and nonlogical 'transitive' inferences (e.g. 'A is a friend of B. B is a friend of C. Therefore, A and C are friends'; Markovits and Dumas 1999).

The developmental picture is not as simple as these findings suggest, however, primarily because not all decision making research has revealed age increases in biases and heuristic use. Klaczynski (2001a) presented adolescents problems derived from the heuristics and biases literature, including deontic and abstract versions of Wason's (1966) selection task, and problems involving conjunctive reasoning, covariation detection, statistical reasoning, the gambler's fallacy, outcome bias, and hindsight bias. On most problems, middle adolescents gave more normative responses than early adolescents (note, however, that children were not included in Klaczynski's research). Nonetheless, the majority of responses at both ages deviated from traditional prescriptions for normative judgments and decisions. For example, older adolescents were guilty of hindsight bias, committed the conjunction and gambler's fallacies, ignored denominators on covariation problems, and based judgments on personal testimonies instead of more reliable statistical evidence. Many adolescents also gave responses were contradictory on the same problems. For instance, judgments that arguments based on small evidential samples were superior to arguments based on larger samples were accompanied by judgments that for claims based on the former type of arguments were *less intelligent* than the claims based on the latter type of argument.

In contrast to the findings of Stanovich and West (1998), normative responses were not always related to general intellectual ability. For example, statistical judgments and covariation judgments were associated with ability, but outcome biases and hindsight biases were not. Nonetheless, a principle components analyses revealed two interpretable factors, easily interpretable within a dual-process framework. The analytic factor comprised deductive reasoning, covariation judgments, statistical reasoning, and the metacognitive abilities to assess the accuracy of judgments. The experiential factor comprised various non-normative biases (e.g. outcome bias, hindsight bias, the conjunction fallacy). Whereas the analytic factor related positively to age and ability, the experiential factor related negatively to age and was unrelated to ability ($r = 03$).

Stanovich and West (2000) argued that ability is related to performance on heuristics and biases tasks primarily when the experiential and analytic systems are in conflict or 'pull' for different solutions. However, solutions to problems that loaded on the experiential factor in Klaczynski (2001a) were not related to ability, even though the two systems should have pulled for different solutions. Thus, applying the Stanovich and West argument to these problems is difficult. Instead, it could be argued that the variables that loaded on the experiential factor did so because the 'pull' or intuitive appeal of biased and heuristically-based responses was so strong on these problems that cues to engage in analytic processing were overwhelmed, even among high ability adolescents. For example, 'statistical reasoning conflict' occurred when participants relied on vivid personal testimony to make judgments, but then rated simultaneously presented statistical evidence as more intelligent.

Although not related to ability, conflicting judgments and other variables that loaded on the experiential factor decreased with age. Age is not therefore a mere proxy for the abilities measured on intelligence tests. Rather, 'something more' is indexed by age; more precisely, I have argued that age declines in experientially-based responses are not entirely dependent on improvements in basic intellectual abilities, but instead result from developmental progressions in the metacognitive abilities and dispositions associated with inhibiting such responses and deliberating alternatives (Klaczynski 2005). These reflective abilities and dispositions are not utilized often, however, possibly because heuristics and other biased responses are sometimes so appealing that no subjective need for intercession arises (see also Thompson, this volume).

Other investigations illustrate more directly the role of developments in intercession skills. Klaczynski (2001b) presented early adolescents, middle adolescents, and adults a set of tasks involving sunk costs, ratio bias, and counterfactual thinking. As in research by Epstein and his colleagues (e.g. Epstein et al. 1992), half the participants in Klaczynski (2001b) were instructed to respond to the problems as they would normally. In a 'logical instructions' condition, participants were told to adopt the perspective of a 'perfectly logical person'.

Sunk cost decisions involve choices between continued pursuit of actions in which investments have been made, but that were not leading to the intended outcomes (e.g. watching a bad movie for which a non-fundable ticket has been purchased), or taking actions more likely to achieve a desired goal (e.g. leaving the movie and having coffee with a friend). Such problems create a dilemma because, to choose the more rewarding action, prior investments must be forsaken (i.e. 'throwing money down the toilet' versus 'water under the bridge'). The sunk cost fallacy is the decision to 'honor' sunk costs to avoid loss of the investments—a tendency attributed to a 'waste not' heuristic (see Arkes and Ayton 1999).

The ratio bias problems required a choice between two logically identical lotteries (e.g. one winner in 10 tickets versus 10 winners in 100 tickets) or the normative judgment that the options were equally desirable. Finally, the counterfactual thinking problems used were selected because, in adults, they often elicit the 'if only' fallacy. The IO fallacy occurs when behaviors are judged more negatively when it *appears* that a negative consequence could have been easily anticipated, and therefore avoided, in one of two logically identical, equally unpredictable situations. For example:

> When parking his new car in a half-empty parking lot, Tom's wife asked him to park in a spot close to where she wanted to shop. Instead, he parked in a spot closer to where he wanted to shop. When he backed out after shopping, the car behind him backed out at the same time, and both cars sustained about $1000 worth of damage. Robert parked his car in the same parking lot when there was only one parking place available. When he backed out after shopping, the car behind him backed out at the same time, and both cars sustained about $1000 worth of damage (adapted from Epstein et al. 1992).

In neither case did the involved party have control over the accident. Yet spontaneously-activated contextualized representations (e.g. Tom had control, Robert had no control) may activate heuristics that link control to fault (i.e. similar to the

'fundamental attribution error'— overestimating the role of dispositional factors when assessing another's actions). Tom's accident appeared avoidable ('if only he had heeded his wife'); Robert's decision, and the resultant accident, arose from uncontrollable circumstances. Despite the fact that both Tom and Robert were equally responsible/accountable for the accidents, adults typically attribute more foolish behavior to Tom (Denes-Raj and Epstein 1994; Epstein et al. 1992).

In both experiential conditions and across tasks, normative judgments were infrequent. More importantly, on each of the three tasks, normative responses increased with age and were more frequent in the 'logical thinking' than in the 'usual thinking' condition. The frequency of non-normative responses in both frames suggests that experiential processing was predominant, although this predominance was clearly stronger in the 'usual' condition. The effects of the logic instructions suggest, however, that participant attempted to increase the extent to which they engaged in analytic processing. Successful shifts toward increased analytic processing required adolescents to inhibit the 'prepotent' response to a problem, evaluate the quality/appropriateness of the prepotent (heuristic) response against this representation, and consider alternative solutions. Despite these shift (or attempted shifts), performance remained poor. At least in the cases of the ratio and sunk cost problems, this poor performance cannot be attributed to lack of analytic competencies because children are capable of comparing ratios (Krietler and Krietler 1986) and, after training, both children and adolescents understand why sunk costs should be avoided and apply this understanding to novel problems (Klaczynski and Cottrell 2004). Poor performance more likely resulted because participants had trouble decontextualizing the task, perhaps because the logic instructions were weak (e.g. relative to the training given in Klaczynski and Cottrell 2004), participants believed that they were, in fact, responding logically in the 'usual' condition (for evidence supporting this explanation, see Amsel et al. in press) and/or because the heuristics activated by the tasks were too appealing for participants to dismiss easily.

The latter explanation has received preliminary support. In the study similar to Klaczynski and Cottrell (2004), Klaczynski (2007a, Study 1) found age increases in a 'make an exception' heuristic. Specifically, 8, 11, and 14-year-olds (and a comparison sample of adults) were presented two types of problems, each of which involved decisions that could have established negative precedents. In these problems, scenarios contained information about publicly-established rules, a specific rule infraction, and the circumstances surrounding the rule infraction. The circumstances of the infractions either appeared extenuating or fell clearly under the rule. To illustrate a 'no-mitigating circumstance' problem (adapted from Baron et al. 1993):

> Mr. Miller, the coach of the basketball team, says that every person on the team has to go to all of the team's practices if they want to play in the games. If a person misses a practice, then he will not be allowed to play in the next game. Bill is the best player on the team. He missed three practices in a row, just because he wanted to watch TV instead. Bill is *so* good that the team will probably win if he gets to play, but the team will probably lose if Bill doesn't get to play. Now, it's the day before the game. What should Mr. Miller do?

In the absence of mitigating conditions, failure to enforce the rule establishes a negative precedent for future violations. In the example, if the rule is not enforced,

the rule may lose its moral force and open the door for Bill and his teammates to legitimately question rule enforcement in the future (see Moshman 1998). When positive precedents are established by enforcing rules, future violations should be deterred; hence, the normative decision in the example is to enforce the rule.

Under some conditions, however, rules can be violated without establishing negative precedents. If, for instance, the conditions surrounding a violation were not anticipated when the rule was created, then the question of whether the violation establishes a negative precedent is more ambiguous (e.g. Bill missed practice because he was doing charity work).

The results shed light on an aspect of decision making (i.e. age trends in precedent decisions) previously investigated only by Baron et al. (1993). Specifically, when problems involved mitigating circumstances, adolescents and adults were more likely than children to advocate rule enforcement. However, in the absence of mitigating conditions, age and the non-normative, 'make an exception' decision was inversely related—suggesting the possibility that, in the absence of strong cues to think analytically, development is marked by an increase in the 'feelings of correctness' (Thompson, this volume) that accompany automatically-activated heuristics. These findings provide yet another demonstration of that, under certain conditions, reliance on heuristics and other cognitively-economical judgment and decision strategies increases with age. At the same time, the findings indicate age increases in cognitive flexibility. That is, whereas adolescents and adults integrated rule understanding with contextual considerations, children's decisions involved more rigid rule adherence. Developments in adolescents' abilities to coordinate social contextual considerations with apparently context-independent rules argues for a developmental progression that parallels, both conceptually and in terms of at ages at which advances are seen, progressions in the metacognitive skills involved in coordinating beliefs and evidence (see Kuhn 2001).

This progression in the ability to integrate considerations of contextual conditions with abstract rules, further supports an earlier point: under some conditions, reliance on contextualized representations, or partially contextualized representations, leads to more adaptive decisions than reliance on decontextualized representations (Buchtel and Norenzayan, this volume). The conflicting age trends found in this research also imply, however, that the challenges involved in overcoming reliance on automatically-cued contextualized representations and avoiding the overgeneralization of the heuristics such representations activate to situations of dubitable relevance become *under certain conditions* more difficult to meet with increasing age. Unfortunately, this issue is one with which theorists and practitioners interested in testing and improving critical thinking and decision making has not yet grappled (see Stanovich, this volume).

Several conclusions can be drawn from developmental research on judgments, risk, and decisions. First, and perhaps foremost, future research needs to utilize more precise methodologies that allow for the disambiguation of biased, fallacious, heuristic, and other non-normative responses from experiential processing predominance. There is a similar clear need to use methods that allow researchers to determine when normative responses are based on experiential processing predominance and when

the same responses result from analytic predominance. Second, if, for the present, we assume that the non-normative responses children, adolescents, and adults typically give when first presented decision and judgment tasks cue contextualized representations and experientially-based responses, then extant evidence indicates that instructions can induce experiential→analytic processing shifts. Although Klaczynski (2001b) showed that very simple instructions can lead to such processing shifts, even among early adolescents, these results should not be taken to imply that experiential→analytic shifts can always be so easily accomplished. This point is supported by the fact that, even after instructions, most participants continued responding in non-normative ways, evidence that shifts from experiential to analytic predominance are often short-lived, and findings that, under some instructional conditions, adults and adolescents can be induced not only to make more non-normative decisions than children, but also to believe that these are superior to simultaneously available normative responses. For instance, after exposure to arguments for non-normative precedent setting decisions, adolescents and adults are more likely than children to change from initially normative responses to non-normative, 'make an exception' decisions, even when circumstances surrounding rule violations clearly do not justify allowing rule infractions (Klaczynski 2007a, Study 2). Third, across the studies reviewed here, it is clear that development is not characterized by a shift from experiential to analytic processing predominance—a conclusion supported by repeated findings that adults do not typically rely on analytic processing. Indeed, the case can be made that increased variability is a fundamental characteristic of development (Jacobs and Klaczynski 2002; Klaczynski 2004). Finally, I have made repeated reference to age-related increases in non-normative responding. Because evidence for such increases can be found in numerous domains and across quite disparate methodological paradigms, they cannot be regarded as atypical or as methodological artifacts. Rather, to the extent that non-normative responses are reflective of experiential processing predominance and are indeed less than optimal responses, the data indicate that development is far more complex than is typically assumed. Development occurs in two or, more likely, multiple processing systems; this observations does not, however, mean that age-related changes in any given phenomena—whether decision making, reasoning, memory, or other forms of cognition and social cognition—can be mapped directly onto changes in the underlying systems or the relative predominance of those systems.

Reasoning

Recent developmental research on conditional reasoning (i.e. reasoning about if *p*, then *q* premises) has focused on four logical forms—*modus ponens* (MP), *modus tollens* (MT), the *affirmation of the consequent* (AC), and the *denial of the antecedent* (DA). In standard logic, the correct conclusion to MP is that q is true; for MT, the correct conclusion is that *p* is not true. Because their conclusions are logically necessary and can be drawn with certainty, MP and MT are determinate logical forms. AC and DA are indeterminate forms because no conclusions can be drawn with certainty.

On problems involving MP and MT, 4–5-year-old children often make logically correct inferences (Harris and Nunez 1996; Chao and Cheng 2000). Under certain conditions,

6 and 7-year-olds draw indeterminate conclusions on AC and DA problems (Markovits and Barrouillet 2002). Interpretations of young children's apparent precocity are quite varied, ranging from conclusions that young children possess reasoning capabilities that are fundamentally similar to those of adults to the more cautious interpretation that children's inferences are not based on decontextualized analyses, but instead are reliant on manipulations that facilitate automatic inferences based on pragmatic rule interpretations (Moshman 1998). Nonetheless, such findings appear in different methodological paradigms, including not only children's valid indeterminate inferences on simple reasoning problems, but also judgments of indeterminacy on more complex scientific reasoning problems (Ruffman et al. 1993; Sodian et al. 1991). Extant data thus appear to provide an accurate picture of children's capacities for valid inferences, although these capacities are likely evinced only under rather narrow conditions.

Other research indicates that neither young children's inferences, nor developmental improvements in conditional inferences, are dependent on problem familiarity: Performance is sometimes better on familiarity problems and sometimes worse when problems are more familiar (Janveau-Brennan and Markovits 1999; Klaczynski and Narasimham 1998a). Instead, my colleagues and I have argued that these, and other findings that appear to indicate that children are as (or more) competent reasoners as adults, are best explained from a dual-process perspective (e.g. Daniel and Klaczynski 2006). In most of our research, and that of Markovits and his colleagues (for review, see Markovits and Barrouillet 2002), participants are instructed only to respond based on the information provided in the problem. Because such task instructions are vague, problems can be represented either as intended by the experimenter or as everyday problems on which they are free to use their intuitions (Evans 2002). When not presented explicit instructions to think logically, at least in part because it is cognitively-economical, adults frequently rely on experiential processing and natural language interpretations.

When theorists are more concerned with the mechanisms responsible for performance variability than with determining logical competence, and the ages at which different logical competencies are acquired, examining responses to 'weak' instructions can provide provocative answers concerning development and individual differences in development. Specifically, the inferences 'invited' by natural language or 'pragmatic' interpretations of conditionals sometimes differ from logical inferences. Under a natural language interpretation, the AC premise (q is true) leads to the invited inference (p is therefore true). The invited inference for DA problems (p is not true) is also determinate (q is not true). By contrast, the logical inferences and the invited inferences for MP and MT problems are the same. Consider the conditional, 'If a person eats too much, then she will gain weight' and the MP premise, 'Alice ate too much' and the question, 'Did Alice gain weight?' Both the logical response and the invited response are 'yes'. For AC, 'Alice gained weight', the natural language interpretation leads to the logically fallacious inference, 'Alice ate too much'. Thus, natural language interpretations invite determinate inferences for all four logical forms; logical interpretations should lead to indeterminate responses for AC and DA and determinate responses for MP and MT. Because the invited and logical inferences are the same for

MP and MT and because experiential processing is more cognitively economical than analytic processing, then—regardless of age—the experiential processing should predominate on these forms.

In addition to instructions, an important determinant of whether a conditional is represented logically or pragmatically is the availability of alternative antecedents to a conditional's consequent (Janveau-Brennan and Markovits 1999; Markovits and Barrouillet 2002). Adolescents and adults typically make the natural language interpretations if few alternative antecedents are associated with a consequent. If conditionals have at least one strongly associated alternative antecedent, logical interpretations are more probable. Although adolescents have superior reasoning abilities and more ready access to alternative antecedents, they are also more familiar with natural language interpretations than children. Thus, when conditionals do not readily activate alternative antecedents, pragmatic interpretations are more probable, experiential processing likely predominates, and the chances of age increases in fallacies, such as AC and DA, increases.

Several predictions follow from these conjectures. First, on MP and MT problems, children and adults should make determinate (and logically correct) inferences; age increases should be minimal. On AC and DA problems with strongly associated alternative antecedents, adolescents should make more indeterminate inferences than children. Second, when consequents are weakly associated with alternative antecedents, adolescents should make *fewer* indeterminate inferences on AC and DA problems. Third, correlations between the two determinate forms and the two indeterminate forms should differ for children and adolescents. Specifically, if experiential processing is predominant in children, then determinate inferences should correlate positively across the four forms. For adolescents, if experiential processing is predominant for MP and MT and analytic processing predominates on AC and DA problems (especially problems with few alternative antecedents), AC and DA inferences should be statistically independent from MP and MT inferences.

To test of hypotheses, Klaczynski and Narasimham (1998a) presented 10, 14, and 17-year-olds Wason's (1966) selection task, open-ended syllogisms, and forced-choice conditionals. Across tasks, modest age increases were found for MP and MT. Logically correct inferences increased with age on problems with strongly associated alternative antecedents—problems that were also relatively *less* familiar. By contrast, the AC and DA *fallacies* increased with age on problems with few alternative antecedents and *more* familiar to participants. For instance, on such problems as, 'If a person exercises a lot, then she will be in good shape. Joan is in good shape. Does Joan exercise a lot?' adolescents affirmed the antecedent more often than children and did so more often than on less familiar conditionals (e.g. 'If a person has a healthy diet, the she will be in good shape'). In a similar study involving somewhat younger participants (8, 10, 12, and 14-year-olds), we examined patterns of correlations among inferences on conditionals with strongly and weakly associated alternative antecedents (Klaczynski et al. 2004). Across ages, MP and MT were positively related, as were AC and DA. Critically, whereas determinate responses across all four forms were related positively prior to adolescence, responses on the determinate and indeterminate forms were independent in adolescents and adults.

Although the combined data from these investigations imply that, on MP and MT problems, experiential processing predominated the thinking of both children and adolescents, the findings also point to different conditions under which age-related experiential↔analytic shifts occur. Age-related shifts from predominantly experiential to predominantly analytic processing are evident and age declines in fallacious inferences are found, for instance, when instructions clearly emphasize the need for logical analyses (Daniel and Klaczynski 2006). Under different conditions (e.g. relatively vague instructions for conditionals with few alternative antecedents), age-related shifts from analytic to experiential processing occur (see Janveau-Brennan and Markovits 1999; Klaczynski and Narasimham 1998a). As for judgments, risk assessments, and decision making, available evidence argues against characterizations of the development of reasoning as involving a general shift from experiential→analytic processing shift.

Belief-motivated reasoning and stereotyping

A similar conclusion can be drawn from developmental research on belief-motivated reasoning and stereotyping. In belief-motivated reasoning, individuals reason about evidence relevant to their beliefs in ways that preserve and perpetuate those beliefs, typically by accepting evidence that supports their beliefs and rejecting evidence that contravenes their beliefs. Belief-biased reasoning is particularly interesting because these reasoning biases (a) illustrate shifts between analytic and experiential processing, (b) suggest the mechanisms that underlie the resilience of beliefs to change, and (c) demonstrate individual differences in analytic/experiential processing predominance and in the abilities/dispositions to override experiential predominance.

My students and I (e.g. Klaczynski and Gordon 1996a, 1996b; Klaczynski and Lavallee 2005; Klaczynski and Narasimham 1998b) have studied how children process logically flawed arguments and scientific evidence (e.g. based on unrepresentative samples, hasty causal inferences, methodologically flawed 'scientific' investigations etc.). The arguments/evidence children are presented leads to conclusions to support, contravene, or has no bearing on strongly-held beliefs (e.g. religion, career goals, social classes, gender). Like adults, children and adolescents scrutinize belief-threatening evidence more carefully than belief-neutral or belief-supportive evidence. Specifically, the evidence is processed analytically, higher-order scientific and statistical reasoning skills are activated, and logical structure is decontextualized from superficial contents. Such processing allows for detection of flaws in the evidence and, as a consequent, the evidence is rejected. When evidence supports beliefs, experiential processing is typically predominant. Evidence is processed at a relatively cursory level and representations are contextualized, triggered by content and based on automatically-activated memories. Justifications for evidence acceptance derive from personal experiences, category exemplars, stereotypes, and simple assertions. Results from several studies (Klaczynski 2000; Klaczynski and Gordon 1996a; Klaczynski and Narasimham 1998a) indicate that reasoning on belief-neutral problems is no more sophisticated than reasoning on supportive problems; reasoning with both belief-supportive and belief-neutral evidence is less complex than reasoning with belief-threatening

evidence problems. Such findings support the dual-process hypotheses that people (both children and adults) typically reason experientially and shift to analytic processing only when motivated by evidence that threatens their beliefs.

A somewhat surprising finding from this research is that the extent to which children, adolescents, and adults vacillate between experiential processing on supportive and neutral problems and analytic processing on belief-threatening problems is very similar. In other words, although the amount of experiential processing interference in reasoning varies little with age, the heuristics and higher-order reasoning abilities used to justify evidence ratings are age-related (see Klaczynski 2000; Klaczynski and Fauth 1997). Nonetheless, the extent to which the responding is biased by beliefs is *not* related to age. Across the childhood and into the adult lifespan (Klaczynski and Robinson 2000) and seemingly without conscious awareness, reasoning fluctuates between higher-order reasoning (e.g. when evidence threatens beliefs) and cursory 'reasoning' apparently based on automatically-activated heuristics (e.g. when evidence supports beliefs). That fact that mature adults are no less biased, and are sometimes more biased, than children and adolescents, suggests either that the metamonitoring abilities required to track the course of reasoning for consistency do not develop as fully as unbiased reasoning requires or these metacognitive skills do indeed develop, but consistency may not have been an important intellectual value. Extant evidence supports both possibilities.

Examinations of the effects of extrinsic accuracy motivation on belief-biased reasoning support the first explanation (Klaczynski and Gordon 1996b; Klaczynski and Narasimham 1998b). Adolescents were told that if they gave thoughtless or inaccurate responses, they would have to justify their responses in front of an audience of authorities. Relative to control conditions, the accuracy instructions had a considerable effect: Because reasoning across all problems (i.e. belief-threatening, neutral, and supportive) was more complex (i.e. justification scores increased, rating scores decreased), we argued that the instructions led to increased analytic processing. However, the extent to which reasoning was biased was *not* affected by the instructions. Even though reasoning improved, differences in the quality of reasoning on threatening and supportive problems were as large in the accuracy conditions as in the control conditions. Thus, we further argued that participants could not consciously control *this type* of bias in their reasoning. That is, the improvements in reasoning complexity observed in the accuracy conditions indicates conscious efforts to reason more 'objectively' than in the control conditions. Not only did these efforts fail to reduce biases, but that failure extended across levels of intellectual ability. Note that these studies contrast with Klaczynski's (2001b, 2007a; Klaczynski and Cottrell 2004) studies of decision making, which showed that arguments, and subtle cues to think logically, significantly diminish the interfering effects of experiential processing on analytic processing.

Nonetheless, in each of the aforementioned studies, some participants were *not* biased (for discussion, see Stanovich and West 2000; Stanovich 1999). In most research, intellectual capacity has explained virtually no variance in biases (Kardash and Scholes 1996; Klaczynski 1997, 2000; Klaczynski and Gordon 1996a, 1996b; Klaczynski and Lavallee 2005). Thus, traditional measures of intelligence either do

not index the skills required to monitor reasoning for consistency or the thinking dispositions that activate these skills. However, Stanovich and West (1997, 2006) have shown that intellectual capacity *does* predict reasoning biases when participants are instructed to think logically. Such findings are in distinct contrast to our findings with accuracy motivation. A plausible explanation for this difference is that the lack of significant correlations in the research of my colleagues and I may have arisen because the within-subjects design cues responses in line with experimenter expectations (Stanovich and West 2007; Toplak and Stanovich 2003). If this were the case, then *higher* ability individuals, adults and older adolescents—those best able to guess the experiment's intent—should be *more* biased than those with less intellectual capacity and children.

An alternative possibility is that individual differences in belief-motivated reasoning have their origins in the thinking dispositions that index inclinations to metacognitive intercede (Klaczynski 2000; Klaczynski and Lavallee 2005; see also Kardash and Scholes 1996). Consistent with the findings of Stanovich and West (1997, 1998), these dispositions accounted for significant variance in reasoning biases. The dispositional level, rather than level of cognitive capacity, appears to be the locus of individual differences in reasoning biases (for an alternative view, and for discussions of levels of analyses in cognitive psychology and, specifically, the algorithmic and epistemic levels, see Stanovich 1999, 2004, this volume). At least in certain methodological paradigms, dispositions to 'be metacognitive' better predict reasoning biases general intelligence. Whereas research on accuracy motivation is highly suggestive of the difficulties children and adults have in consciously controlling belief-related, automatically-cued interference, findings of individual differences in biases at the epistemic level of analysis suggest that the capacity to control such interference can be learned. Despite calls from interventionists and critical thinking theorists, research dedicated to the development of metacognitive dispositions, and the relationship of developments in these dispositions to various metacognitive and executive function abilities, has been minimal (for discussions, see Hofer and Pintrich 2002; Kuhn et al. 2000).

Belief-motivated reasoning is a basic, and sometimes adaptive, feature of mature cognition. However, its close ties to unrealistic optimism, stereotype maintenance, belief polarization hint at the limits of this adaptive value in technologically-advanced societies (Klaczynski 2000; Klaczynski and Fauth 1996). Developmental research on stereotyping has most often involved examinations of age trends in gender, racial, and more recently, obesity stereotypes, and predictors of these stereotypes (e.g. masculinity, femininity; causal beliefs). Given the centrality of stereotyping to social and developmental psychology, and its relevance to both dual-process theoretic issues and applied issues in education (e.g. critical thinking interventions), it is unfortunate that researchers have been far less concerned with the links between stereotypes and reasoning or methodological innovations that could afford testing dual-process hypotheses. More relevant to issues surrounding dual-process theories, and issues raised in this chapter, is research linking belief-biased reasoning, stereotypes, development, and rationality.

An illustration of the concept of 'degrees of rationality', as discussed by Reyna and her colleagues (2003; Reyna and Farley 2006), is provided by Klaczynski

and Aneja (2002). In each of a series of vignettes, 7, 9, and 11-year-old children were presented large samples of boys (or girls) *and* small samples of boys (or girls) engaged in a prosocial, gender-neutral activity, and were asked to indicate the generalizability the behaviors of the children in two samples. Consistent with previous research on gender stereotypes, children generalized more from same-gender scenarios than from other-gender scenarios. Of greatest interest was the finding that, at all three ages, the magnitude of my-gender biases was constrained by sample size. Specifically, on large sample problems, children generalized more from the same-gender than to the other-gender samples; the same was found on small sample problems. However, children generalized more from large samples of the *other*-gender than from *small* my-gender samples. Thus, 7–11-year-old children were rational *to an extent*: generalizations were more extensive from large than from small samples, even when the large evidential samples described the other-gender positively. *Within* sample sizes, however, even the oldest children generalized more from same-gender than from other-gender problems. This demonstration of degrees of rationality is illustrated in Figure 12.1.

The age decline in reasoning biases and gender stereotyping reported by Klaczynski and Aneja (2002) cannot be assumed to reflect either a domain-general or domain-specific developmental trajectory. Although considerable research indicates that gender biases decline during certain age periods (Ruble and Martin 2002), such declines are less apparent in areas less subject to socialization pressures for unbiased self-presentation. As an example, consider obesity.

Obesity stereotypes are present as early as 3 years of age and become stronger during early childhood (Cramer and Steinwert 1998; Musher-Eizenman et al. 2004).

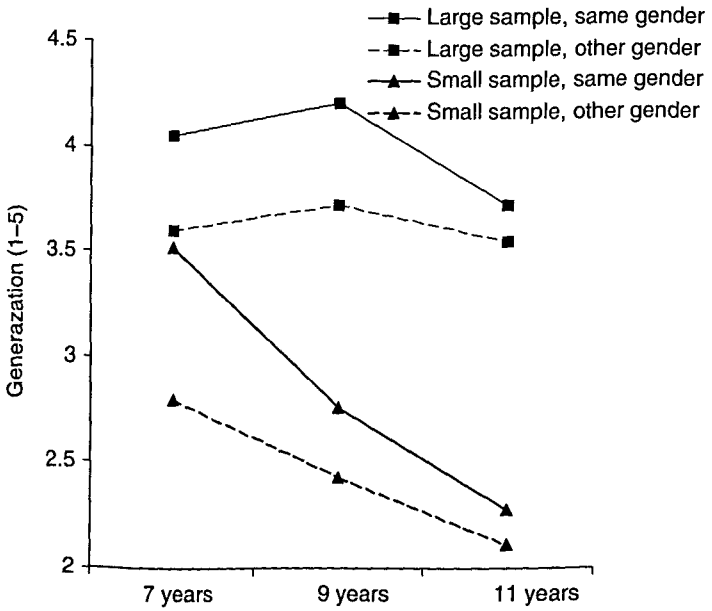

Fig. 12.1 Levels of rationality? Age and sample size effects of same- and other-gender generalizations (adapted from Klaczynski and Aneja 2002).

During later childhood and into adolescence, age increases in 'thin idealization' (Smolak et al. 2001), pressures to be physically attractive, attention to members of the other-sex, and exposure to jokes about the obese, led us to predict that the magnitude of obesity stereotypes would increase further during adolescence.

Recently, Klaczynski and Daniel (in press) presented children and adolescents brief descriptions of obese and average-weight targets. Subsequently to reading each vignette, participants made generalizations to other individuals who 'looked like' the target and completed a personality checklist. Consistent with expectations, anti-obesity biases—differences between average weight generalizations and stereotypes and obese generalizations and stereotypes—increased with age. Importantly, the observed increases in biases could not be explained by variables that, according to most prominent theories of obesity stereotypes, should have mediated the age-obesity bias association (e.g. thin idealization beliefs, beliefs that obesity is caused by characterological flaws, body esteem).

These findings, in combination with research illustrating the early emergence of obesity stereotypes and findings that behavioral avoidance of the obese does not diminish even when explicit stereotypes and attributions change (e.g. from beliefs that obese is caused by within-individual variables, such as laziness, to beliefs that obesity results primarily from uncontrollable physical variables, such as genetic dispositions to metabolize food slowly), indicate that neither obesity stereotypes nor the stigma associated with obesity can be adequately explained by current theories (e.g. attribution theory, social identity theory). Instead, age increases in obesity stereotyping, like age increases in other types and forms of heuristics (e.g. representativeness, 'make an exception') and biases, can be explained by age increases in the strength of an experientially-activated 'thin is in' heuristic. However, increased reliance on such heuristics cannot entirely explain behavioral reactions to obesity—unless activation of these biasing heuristics is also associated with the preconscious belief that 'obesity is contagious'. This explanation, elaborated further in the next section, again argues against black-and-white conceptions of rationality and for the notion that rationality is best conceptualized in terms of levels.

Magical thinking

Traditional theories of magical thinking (e.g. Piagetian, neo-Piagetian) assume that magical thinking declines with age. Support for this claim is available in studies of animism, wherein older children are less likely to attribute human-like qualities to animals and representations (e.g. stuffed toys) of animals. However, despite decreases in beliefs in such characters as Santa Claus, the Easter Bunny, and the Tooth Fairy, most cultures sanction certain magical beliefs (e.g. religious practices). For example, Catholics receive communion, the 'body of Christ' embodied in a wafer. There is little doubt that superstitious beliefs, beliefs that cannot reliably be supported be evidence or logic, are commonplace. Critical questions, are: Do children have magical beliefs beyond those sanctioned by their cultures and do these coexist with (relatively) rational beliefs? How do such beliefs change with age? To the extent that these beliefs persist, what mechanisms underlie their maintenance?

Subbotsky (2000a, p.39) answered the first question in the affirmative, 'phenomenalistic thinking and scientific understanding ... coexist throughout the life span'. In a provocative demonstration, children were presented the Muller-Lyer illusion. Not surprisingly, most children claimed that a >—< ruler was longer than a ↔ ruler. Children compared the rulers and determined that they were actually equally long. Next, children were told they could have an interesting stamp, placed just beyond their reach, if they could retrieve it without leaving their seats. Although most children selected the dovetailed ruler, none could provide a rational reason for selecting it.

Both children and adults reject magic at the verbal, conscious level, and yet 'accept' magic in their actions (Subbotsky 2000a, 2000b). For instance, after casting a spell and placing an object in a cleverly designed box, participants open the box and found that the object was badly damaged. When no spell was cast, nothing happened to the object. After then placing a valuable object of their own in the box, neither children nor adults were willing to let the experimenter cast the spell—all the while denying that the spell made a difference.

That adults are susceptible to and affected by implicit magical beliefs has also received support in the work of Rozin and colleagues. For instance, adults will wear washed clothes previously worn by others, but not washed clothes previously worn by AIDS victims. In the latter case, this refusal is accompanied by explicit acknowledgment that AIDS can be contracted only through intimate contact (Rozin et al. 1992). Even preschoolers have a limited understanding of contamination and contagion (Hejmadi et al. 2004; Inagaki and Hatano 2006; Siegal 1988), although young children are prone to overgeneralizing.

Evidence that 5–6 year-old children have a limited understanding of how illnesses are contracted and transmitted, led Klaczynski (2008) to a novel hypothesis regarding the avoidance children exhibit toward the obese. Recall that attribution theory explains neither children's avoidance of obese peers nor developmental increases in stereotypes obesity and generalization biases. Medical evidence indicates that obese individuals display many symptoms similar to those of contagious illnesses. For instance, compared to those of average weight, the obese have more difficulty exerting themselves, more labored breathing, sweat more profusely, fatigue more easily, are more likely to have facial and abdominal discolorations, suffer from more joint pain, and generally are more susceptible to illnesses. Given these similarities to true illnesses, for otherwise naïve children, there may be some adaptive value to avoiding obese children, particularly when the obese children are unfamiliar. Thus, a degree of caution toward and the stigmatization of the obese have a degree of rationality.

By the 'laws of sympathetic contagion' (Nemeroff and Rozin 2000; Rozin and Nemeroff 2002), people avoid contact with people or objects associated with the stigmatized, implicitly believing that contact may lead to the contraction of one of more of the properties associated with the stigma. Untouchables in Indian culture provide one example; the unwillingness of adults to wear clothing previously worn by AIDS victims is another example. Together with the speculations that (a) children recognize some of the basic symptoms of contagious illnesses and (b) obese persons exhibit many of these same symptoms and, therefore, are stigmatized (in this view, stigmas develop *prior* to stereotypes), this information led to the following hypothesis.

Both American children and Chinese children, who are less familiar with obesity, would react more negatively to an object (in this case, a beverage) associated with an obese child than the same object associated with an average weight children. Further, this negativity would (a) increase with age, as children become more exposed to negative depictions of obesity, and (b) be more prominent when children were primed to the ingestion→illness→contagion association than when primed only to ingestion→illness.

Seven and 10-year-old Chinese and American children tasted small samples of identically-flavored drinks, presented by an experimenter purported to represent a company that was testing a new drink. This hypothetical company used children to help make the drink; children's pictures, as a reward for their help, were placed on the labels of the bottles for the drinks they 'created'. Pictures varied by 'creator' gender, ethnicity, and weight (obese, average). After hearing one of two priming stories, children sampled each drink and rated it along several dimensions.

Across cultures and priming conditions, 'obese-created' drinks tasted worse and were more likely to result in illness than 'average-created' drinks. In the illness→contagion condition, the difference between taste ratings for obese-created drinks and average-created drink increased with age (see Figure 12.2). This bias increased with age among Caucasian, but not Chinese, children. Three days later, children were asked to remember the worst tasting drink. Verbatim memory for this drink's creator was poor. However, consistent with fuzzy-trace theory, gist memory—memory for the general category to which the drink creators belonged—was far superior when creators were obese children. Finally, participants more often created the false memory that a child in the priming stories was an obese creator than an average creator.

The effects of obese labels on children's drink preferences, in combination with priming effects and the gist and false memory data, expand research on magical thinking to social contagion and establish a link to memory. That the findings were generally consistent across cultures—one of which, China, has relatively few obese

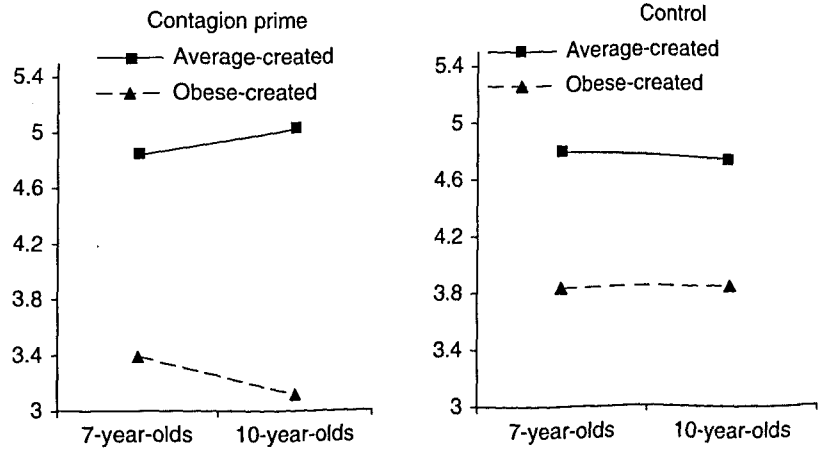

Fig. 12.2 Age and priming effects on taste ratings of average- and obese-created drinks (adapted from Klaczynski 2008).

children, does not publicly endorse negative characterizations of the obese, and does not constantly shower children with depictions of the 'thin ideal' (at least in the rural areas and small cities)—makes difficult an explanation that does not involve experiential processing. Specifically, unless the 'obese creators' left some negative essence on the drinks and unless an implicit belief in this essence existed, then children's reactions should not have differed for these drinks and average-created drinks. That these processes occurred at an implicit level is reinforced by the finding that this effect was stronger when children were primed to the notion that ingestion-related illnesses can be contagious. Of equal importance: to the extent that children's reactions to the obese were founded on perceived similarities with contagious illnesses, their responses were rational ... to a degree.

Conclusions and recommendations

Several conclusions follow from the evidence presented in this chapter. First, development cannot be explained without recourse to dual-process theories. These theories have led to and been supported by research in several developmental domains: Memory, decision making, reasoning, motivated reasoning, stereotyping, and magical thinking. Second, development cannot be characterized by an 'all or nothing' shift from predominantly experiential to predominantly analytic processing (or vice versa). Third, dual-process theories currently in vogue can be integrated into a more encompassing developmental theory. However, fuzzy-trace theory distinguishes itself other dual-process models in its focuses on levels of rationality and intuition as advanced reasoning (Reyna and Farley 2006). Fuzzy-trace theory also emphasizes two types of 'quick and easy' thinking: One is similar to experiential processing as discussed here; the second is a form of higher-order reasoning based on gist. These differences do not make fuzzy-trace theory incompatible with the analytic-experiential theory outlined here. Research on gender stereotyping and children's reactions to drinks created by obese children illustrates the utility of viewing responses in terms of degrees of rationality. Similarly, the two forms of rapid reasoning and decision making identified by fuzzy-trace theories are both experiential in nature, but differ in their probabilities of leading to adaptive responses.

To conclude, recent research supports dual-process theories as replacements for unidirectional theories. Despite recent theoretical and empirical advances, dual-process researchers need to establish the conditions under which counterintuitive age trends are to be expected (Klaczynski and Daniel in press) and establish *developmental* criteria for distinguishing between experientially- and analytically-produced responses. The latter issue is particularly important because non-normative responses given by children may well reflect analytic processing errors. Achieving these ends requires careful inspection of the methodologies used to assess age-related change and, subsequently, employing methodologies that afford greater precision. As Thompson (this volume) and Klaczynski (2001a) argue, non-normative responses may be produced experientially or analytically; the same is true of normative responses. For instance, when young children produce correct conditional inferences, current methodologies do not allow conclusions regarding experiential or analytic

processing competence. Among other possibilities, new methodologies should attempt to determine the neural and physiological bases of analytic and experiential processes and how these change with age, assess speed of processing to better establish which systems are predominant during different tasks and under different conditions, and increase the use of priming and training techniques.

The range of issues with which developmental dual-process theorists must grapple is extensive, particularly because researchers must consider age changes in the nature and manifestation of different processes. Consider Thompson's (this volume) argument that 'feelings of rightness' often accompany experientially-based output. Determining the ontogeny of such feelings is critical for better understanding developments in decision making and reasoning. However, methodological problems loom large. Familiarity with retrieval cues and fluency of processing, hypothesized determinants of feelings of rightness, increase with age. Increases in the perception that material is easier to process are associated with increases in familiarity and decreases in task difficulty. Because neither perception is necessarily accurate, older children may sometimes spend less time processing material than younger children, not simply because they have superior analytic abilities, but also because they perceive tasks as relatively easy. Age increases in non-normative responding may therefore sometimes arise because of misleading perceptions of task difficulty, misleading 'correctness' feelings, misattributions concerning ability to perform a task (e.g. triggered by ease of processing), and overconfidence (e.g. triggered by feelings of familiarity and rightness). Feelings of rightness may also cue a type of analytic responding not discussed in this chapter: the construction of justifications/rationalizations for an erroneous responses which, in turn, serve to increase response confidence.

Thus, even when the requisite analytic competencies have been acquired, metacognitive intercession by no means guarantees normative responding and, in some cases, may 'backfire'. Further, the application of analyses, such as Thompson's, to developmental phenomena presents numerous methodological challenges. For example, the validity of age comparisons depends on designing instructions and tasks that have equivalent meaning across ages. As task complexity increases, the difficulty of establishing age equivalence increases. The existence of such challenges in no way diminishes the importance of studying age changes in intuitions, the responses that intuitions may trigger, and children's confidence in these responses. Instead, great care must be taken to study development, particularly if our goal is to understand development in multiple processing systems and the mechanisms that afford interactions among these systems.

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