

Representation of Objects and Events: Why Do Infants Look So Smart and Toddlers Look So Dumb?

Rachel Keen¹

Department of Psychology, University of Massachusetts, Amherst, Massachusetts

Abstract

Research has demonstrated that very young infants can discriminate between visual events that are physically impossible versus possible. These findings suggest that infants have knowledge of physical laws concerning solidity and continuity. However, research with 2-year-olds has shown that they cannot solve simple problems involving search for a hidden object, even though these problems require the same knowledge. These apparently inconsistent findings raise questions about the interpretation of both data sets. This discrepancy may be resolved by examining differences in task demands.

Keywords

infant cognition; development; search tasks

A paradox has emerged in the developmental literature. On the one hand, a wealth of research from more than a decade of exciting studies shows that very young infants have knowledge of physical laws concerning continuity and solidity (Baillargeon, Graber, DeVos, & Black, 1990; Spelke, Breinlinger, Macomber, & Jacobson, 1992). On the other hand, recent work has revealed a surprising lack of such knowledge in children between 2 and 3 years of age (Ber-

thier, DeBlois, Poirier, Novak, & Clifton, 2000; Hood, Carey, & Prasad, 2000). The question is raised: Are there true discontinuities, even regressions, in children's concepts of the physical world? Or can the discrepancies between the infant and the toddler data sets be resolved by pointing to differences in task requirements? Or perhaps the explanation lies in differences in methodology. For example, in the infant studies the dependent measure is looking, and in the toddler studies it is active search. Whatever the explanation, this paradox must be resolved before a comprehensive theory of early cognitive development can be constructed.

Beginning with the seminal article by Baillargeon, Spelke, and Wasserman (1985), the emerging picture of infants has been that 3- to 4-month-olds show a stunning sophistication in their perception of the physical world. The typical paradigm in this line of research entails the presentation of an event (e.g., a rotating screen in Baillargeon et al., 1985; a rolling ball in Spelke et al., 1992) during repeated trials (referred to as *habituation* trials). Test trials consist of equal numbers of "possible" (*consistent*) events, which accord with the natural laws of physics, and "impossible" (*inconsistent*) events, which break those laws. The assumption is that if infants look longer at inconsistent than at consistent events, they have detected an incongruence with the physical law.

INFANT STUDIES ABOUT OBJECT AND EVENT REPRESENTATION

The procedure in the infancy studies can be clarified by considering an example from Experiment 3 in Spelke et al. (1992). During habituation trials, 3-month-old infants saw a ball roll from the left and disappear behind a screen. A bright blue wall protruded above the screen. When the screen was lifted, the ball could be seen resting against the wall on the right side of the display. Following these trials, an obstacle was placed on the track to the left of the wall, with the top-most part of the obstacle, as well as the blue wall, showing above the screen. On test trials, the ball was again rolled from left to right. For the inconsistent event, when the screen was raised the ball was resting in the old place by the wall, so that it seemed to have violated rules of solidity (i.e., two solid objects cannot occupy the same space at the same time) and continuity (objects exist continuously and move on connected paths over space and time). By appearing at the far wall, the ball seemed to have moved through the solid obstacle or discontinuously jumped over it. For the consistent event, when the screen was raised the ball was resting against the obstacle, a novel position but one that conformed to physical laws. The infants looked significantly longer at the inconsistent event than at the consistent event. A control group saw the ball in the same positions when the screen was raised, but the ball's movement had not violated any physical laws. This group looked at the ball equally in the old and novel locations, thus indicating that they had no intrinsic preference for either display and no preference for the original position.

From this and other experiments, investigators have drawn the conclusion that very young infants reason about objects and events by drawing on some form of knowledge about solidity and continuity (Baillargeon, 1993; Spelke et al., 1992).

SURPRISING RESULTS FROM TODDLERS

The discordant results from toddlers come from experiments presenting the same type of physical event—a rolling ball that goes behind a screen and stops—but in this case the child's task is to actually find the ball (Berthier et al., 2000). The apparatus (see Fig. 1) features a wooden screen with four doors that hides the progress of the ball down the track. The ball is always stopped by a barrier, which can be positioned at any of the four doors. The cue to the ball's location is the top of the barrier protruding

several centimeters above the screen. If the child understands physical laws of solidity and continuity, he or she should open the door by the barrier. Test trials consist of the experimenter placing the barrier on the track and lowering the screen to conceal the track. Then the experimenter draws the child's attention to the ball and releases it at the top of the track. Finally, the child is invited to open a door to find the ball.

In Figure 2, the columns labeled "opaque" show individual performance on this task in the study by Berthier et al. (2000). Children under 3 years old performed no better than would be expected if they were simply guessing at the ball's location. Of 16 children in each age group, no 2-year-old and only three 2.5-year-olds performed above chance levels; 13 of the 3-year-olds did so, however. (Note: Data for 3-year-olds are not displayed in Fig. 2.) The almost total lack of success for children under 3 years of age was quite surprising, and in a

series of studies my colleagues and I have sought to understand why their performance is so poor.

Offering more visual information about the ball's trajectory seemed like a reasonable way to help the toddlers (Butler, Berthier, & Clifton, 2002). We replaced the opaque wooden screen with a transparent one of tinted Plexiglas, leaving four opaque doors to hide the bottom of the wall and the ball's final resting position. Otherwise we kept the procedure and the rest of the apparatus the same. Now children had a view of the ball as it passed between doors, with the additional cue of no emergence beyond the wall. Despite this substantial increase in visual information about the ball's whereabouts, 2-year-old children still had great difficulty in searching accurately: Only 6 out of 20 children performed above chance. Of the 12 children tested at 2.5 years of age, 10 were above chance, so this age group benefited notably from the additional information (see data in Fig. 2 labeled "clear").

We also recorded eye gaze, monitored from a digital video camera trained on the child's face. Children at both ages were highly attentive as the ball was released, and they tracked its movement down the ramp on 84% of trials. Two aspects of their tracking behavior predicted their response: the point where they stopped tracking the ball and whether they broke their gaze before choosing a door. For older children, tracking the ball to its disappearance was the most typical pattern, and this virtually guaranteed they would open the correct door. A different story emerged for the 2-year-olds. Like 2.5-year-olds, they typically tracked the ball to its final location, but this did not ensure success. If they looked away after correctly tracking the ball, they made errors, although this was not the case for 2.5-year-olds (Butler et al., 2002).



Fig. 1. View of the apparatus used for the toddler task. The child is opening the third door, and the ball, resting against the wall, is visible through the door. From "Where's the Ball? Two- and Three-Year-Olds Reason About Unseen Events," by N.E. Berthier, S. DeBlois, C.R. Poirier, J.A. Novak, and R.K. Clifton, 2000, *Developmental Psychology*, 36, p. 395. Copyright by the American Psychological Association. Reprinted with permission of the author.

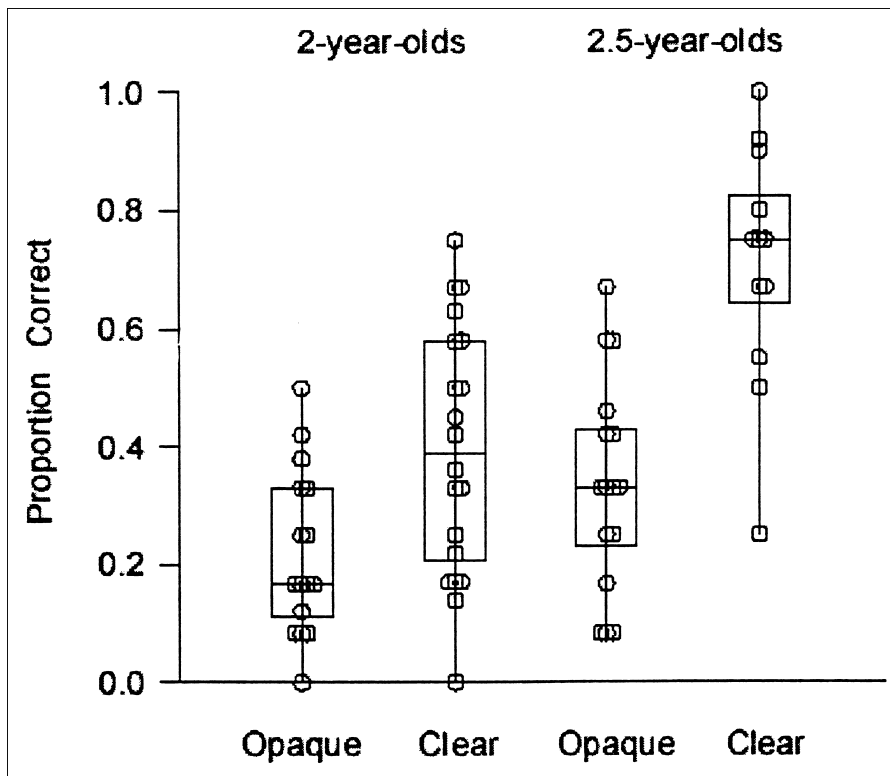


Fig. 2. Proportion of trials correct on the first reach for 2- and 2.5-year olds. Results are shown separately for trials with an opaque screen and a transparent screen. Each circle represents one child's performance. The boxes enclose the second and third quartiles of the distributions, and the horizontal lines in the boxes are the medians. From "Two-Year-Olds' Search Strategies and Visual Tracking in a Hidden Displacement Task," by S.C. Butler, N.E. Berthier, and R.K. Clifton, 2002, *Developmental Psychology*, 38, p. 588. Copyright by the American Psychological Association. Reprinted with permission of the author.

IS THE PROBLEM KEEPING TRACK OF HIDDEN MOVEMENT?

A second visual manipulation was tried (Mash, Keen, & Berthier, in press). We hypothesized that if the children were given a full view of the ball's trajectory until it came to rest against a wall, they would be able to search correctly. In effect, we reversed the sequence of events that concealed the ball: In our previous studies (Berthier et al., 2000; Butler et al., 2002), the screen was first positioned in front of the ramp, hiding most of it from view, and then the ball was released at the top of the ramp, going out of sight while still moving. In this new study, the ball rolled down the

ramp and came to a stop by a wall, then the screen was lowered to conceal both the ramp and the ball. At that point, the child's task was the same as in previous studies—open a door to find the ball. Note, however, that in this case the child did not have to reason about solidity and continuity in order to find the ball. Keeping track of its position behind the screen was all that was required.

Allowing complete access to the ball's movements benefited the older children somewhat, but the great majority of 2-year-olds still had enormous problems. Only two out of eighteen 2-year-olds tested performed above chance, whereas seven out of eighteen 2.5-year-olds did. As when we used the clear screen, gaze offered clues as to

why children failed. If children looked at the ball as the screen was lowered and maintained this orientation until opening a door, they were correct about 90% of the time. Most children, however, broke their gaze, which resulted in errors. Merely watching as the screen was lowered over the ramp and ball did not aid search; only a continuous fixation up to the point of choosing the door led to success.

WHAT ABOUT TASK DIFFERENCES?

In the infant task, 3- to 4-month-old infants looked longer at physically impossible events than at possible events (Baillargeon et al., 1990; Spelke et al., 1992). No prediction was required on the infants' part, as they simply reacted to a visual array of an object in the wrong place or the right place. In contrast, the search task used with toddlers involved prediction and planning within a more complex apparatus. In order to make the infant and toddler tasks more comparable, we designed a looking-time task in which the same door apparatus was used, but the children never opened a door (Mash, Clifton, & Berthier, 2002). Instead, they observed the same events as before, but a puppet, Ricky the raccoon, opened the door.

Most of the time, Ricky opened the correct door and removed the ball. But on test trials, Ricky opened an incorrect door (no ball found, a physically possible, or consistent, event) or opened the correct door but found no ball (a physically impossible, or inconsistent, event). After the door was opened and no ball was found, the experimenter raised the screen to reveal the ball resting against the wall (consistent event) or beyond the wall (inconsistent event). This visual array is highly similar to what infants saw

on the test trials of Experiment 3 in Spelke et al. (1992), described earlier. Like the infants, the toddlers looked longer at the inconsistent placement of the ball than at the consistent placement. This result was independently corroborated by a looking-time study with toddlers that used a similar apparatus but a different procedure in which the experimenter opened the doors while the child watched (Hood, Cole-Davies, & Dias, 2003).

CONCLUSIONS

To interpret the results of these studies, first consider what can be ruled out as an explanation of toddlers' poor performance in this search task. The results from the original study using an opaque screen (Berthier et al., 2000; and from Hood et al., 2000, as well) suggested that toddlers have no knowledge of continuity or solidity. In the clear-screen study (Butler et al., 2002), 2-year-olds again failed to recognize the barrier's role in stopping the ball. Maintaining gaze on the spot where the ball disappeared was the behavior most predictive of correct door choice—more evidence that toddlers did not reason about this physical event. But unexpectedly, taking away the reasoning requirement did not lead to success. Observing the disappearance of a stationary ball should have enabled the children to select the correct door if the problem were either hidden movement or the necessity to reason about the barrier's role (Mash et al., in press). The fact that performance remained poor in this condition rules out these explanations of toddlers' poor search performance. The puppet study, which used looking as the response rather than reaching, found that 2-year-olds, like infants, looked longer at the inconsistent event (Mash et al., 2002). This

study rules out the disconcerting possibility that infants are endowed with knowledge about physical events that gets lost during development, and is regained around 3 years of age. Finally, although infants and toddlers both fail in search tasks that require a reaching response, previous work not discussed here demonstrated that 6-month-olds will reach for objects hidden by darkness (Clifton, Rochat, Litovsky, & Perris, 1991). Thus, it is not the response of reaching, in contrast to looking, that is the cause of infants' and toddlers' failure, but rather a problem of knowing where to search.

What could be the toddlers' problem in the search task? A distinct possibility, already mentioned, is the requirement of prediction. In order to plan and execute a successful search, toddlers had to know the ball's location in advance. Moreover, they had to coordinate this knowledge with appropriate action. Further research is needed to determine if either or both of these aspects are critical. One means of exploring this possibility is to devise new tasks that require location prediction but have fewer spatial elements to be integrated than the ball-barrier-door task and require simpler action plans.

A second prime issue needing further investigation is the relation between gaze behavior and search. Choice of the correct door was associated with continuous gaze at the hiding event; gaze breaks before searching were fatal to success. These data imply that children did not use sight of the barrier's top as a cue for the correct door. Likewise, adults faced with an array of 20 identical doors with no further marker might well use unbroken gaze at the point of disappearance as a strategy. If confusion among identical doors is the children's problem, then making the doors distinct should help. This manipulation coupled with careful

analysis of gaze could determine whether the toddlers' problem is simply spatial confusion among identical doors. If so, the interesting question remains as to why the barrier's top does not cue location.

Finally, a theoretical issue is unresolved. The results for the looking-time task indicate that toddlers, and even infants, have some knowledge about the ball's expected location, but the contents of their knowledge is unclear. According to Spelke (Spelke et al., 1992), the principles of continuity and solidity are part of a constant core of physical knowledge that infants are endowed with. Infants of 3 to 4 months in age mentally represent hidden objects and can reason about an object's motion being constrained by continuity and solidity. Spelke et al. (1992) did not claim, however, that the infants in their study could predict the ball's location, and the toddler data suggest that infants' and even 2-year-olds' reasoning may be limited to recognizing after-the-fact incongruent events. If so, perceptual recognition of implausible event outcomes seems like a valuable building block on which to construct further knowledge, and eventually prediction, about the physical world.

Recommended Reading

- Bertenthal, B.I. (1996). Origins and early development of perception, action, and representation. *Annual Review of Psychology*, 47, 431–459.
- Bremner, J.G. (1997). From perception to cognition. In G. Bremner, A. Slater, & G. Butterworth (Eds.), *Infant development: Recent advances* (pp. 55–74). Hove, England: Psychology Press.
- Spelke, E.S. (1991). Physical knowledge in infancy: Reflections on Piaget's theory. In S. Carey & R. Gelman (Eds.), *The epigenesis of mind: Essays on biology and cognition* (pp. 133–169). Hillsdale, NJ: Erlbaum.
- Willatts, P. (1997). Beyond the "Couch Potato" infant: How infants use

their knowledge to regulate action, solve problems, and achieve goals. In G. Bremner, A. Slater, & G. Butterworth (Eds.), *Infant development: Recent advances* (pp. 109–135). Hove, England: Psychology Press.

Acknowledgments—This research was supported by Grant HD27714 from the National Institutes of Health and Research Scientist Award MH00332 from the National Institute of Mental Health to Rachel K. Clifton (now Rachel Keen). I am grateful to Neil Berthier, my collaborator in all of these studies, and to the other collaborators who contributed to various phases of this work.

Note

1. Address correspondence to Rachel Keen, Department of Psychol-

ogy, Tobin Hall, University of Massachusetts, Amherst, MA 01003.

References

- Baillargeon, R. (1993). The object concept revisited: New directions in the investigation of infants' physical knowledge. In C.E. Granrud (Ed.), *Visual perception and cognition in infancy* (pp. 265–315). Hillsdale, NJ: Erlbaum.
- Baillargeon, R., Graber, M., DeVos, J., & Black, J. (1990). Why do young infants fail to search for hidden objects? *Cognition*, *36*, 225–284.
- Baillargeon, R., Spelke, E., & Wasserman, S. (1985). Object permanence in five-month-old infants. *Cognition*, *20*, 191–208.
- Berthier, N.E., DeBlois, S., Poirier, C.R., Novak, J.A., & Clifton, R.K. (2000). Where's the ball? Two- and three-year-olds reason about unseen events. *Developmental Psychology*, *36*, 394–401.
- Butler, S.C., Berthier, N.E., & Clifton, R.K. (2002). Two-year-olds' search strategies and visual tracking in a hidden displacement task. *Developmental Psychology*, *38*, 581–590.
- Clifton, R., Rochat, P., Litovsky, R., & Perris, E. (1991). Object representation guides infants' reaching in the dark. *Journal of Experimental Psychology: Human Perception and Performance*, *17*, 323–329.
- Hood, B., Carey, S., & Prasada, S. (2000). Predicting the outcomes of physical events: Two-year-olds fail to reveal knowledge of solidity and support. *Child Development*, *71*, 1540–1554.
- Hood, B., Cole-Davies, V., & Dias, M. (2003). Looking and search measures of object knowledge in pre-school children. *Developmental Psychology*, *39*, 61–70.
- Mash, C., Clifton, R.K., & Berthier, N.E. (2002, April). Two-year-olds' event reasoning and object search. In L. Santos (Chair), *Interpreting dissociations between infant looking and reaching: A comparative approach*. Symposium conducted at the meeting of the International Society on Infant Studies, Toronto, Ontario, Canada.
- Mash, C., Keen, R., & Berthier, N.E. (in press). Visual access and attention in two-year-olds' event reasoning and object search. *Infancy*.
- Spelke, E.S., Breinlinger, K., Macomber, J., & Jacobson, K. (1992). Origins of knowledge. *Psychological Review*, *99*, 605–632.

Why People Fail to Recognize Their Own Incompetence

David Dunning,¹ Kerri Johnson, Joyce Ehrlinger, and Justin Kruger

Department of Psychology, Cornell University, Ithaca, New York (D.D., K.J., and J.E.), and Department of Psychology, University of Illinois, Champaign-Urbana, Illinois (J.K.)

Abstract

Successful negotiation of everyday life would seem to require people to possess insight about deficiencies in their intellectual and social skills. However, people tend to be blissfully unaware of their incompetence. This lack of awareness arises because poor performers are doubly cursed: Their lack of skill deprives them not only of the ability to produce correct responses, but also of the expertise necessary to surmise that they are not producing them. People base their perceptions of performance, in part, on their preconceived notions about their skills.

Because these notions often do not correlate with objective performance, they can lead people to make judgments about their performance that have little to do with actual accomplishment.

Keywords

self-evaluation; metacognition; self-concept; overconfidence; performance evaluation

Real knowledge is to know the extent of one's ignorance.

—Confucius

Confucius' observation rings just as true today as it did 26 centuries ago. To achieve and maintain

an adequate measure of the good life, people must have some insight into their limitations. To ace an exam, a college student must know when he needs to crack open his notebook one more time. To provide adequate care, a physician must know where her expertise ends and the need to call in a specialist begins.

Recent research we have conducted, however, suggests that people are not adept at spotting the limits of their knowledge and expertise. Indeed, in many social and intellectual domains, people are unaware of their incompetence, innocent of their ignorance. Where they lack skill or knowledge, they greatly overestimate their expertise and talent, thinking they are doing just fine when, in fact, they are doing quite poorly.

IGNORANCE OF INCOMPETENCE: AN EXAMPLE

Consider the following example. In a sophomore-level psychology

Who Develops Posttraumatic Stress Disorder?

Emily J. Ozer¹ and Daniel S. Weiss²

¹University of California-Berkeley School of Public Health and ²Department of Psychiatry, University of California-San Francisco School of Medicine

ABSTRACT—*Nearly half of U.S. adults experience at least one traumatic event in their lifetimes, yet only 10% of women and 5% of men develop posttraumatic stress disorder (PTSD). Why this is so is among the most central questions in current PTSD research. This article reviews the current status of knowledge about who develops PTSD, discussing the strengths and weaknesses of the evidence. We describe the major models used to understand responses to traumatic events, as well as future research directions. We also propose that an exclusive focus on individual differences and individual intervention overlooks opportunities to reduce the prevalence of PTSD by modifying factors at the neighborhood, community, or national level.*

KEYWORDS—*PTSD predictor; dissociation; traumatic event; prevention*

The response to traumatic stress varies widely, ranging from transient disruption of functioning to the chronic clinical condition known as posttraumatic stress disorder (PTSD). Interest in and knowledge about PTSD increased dramatically after its diagnosis was formalized in 1980, but study of the effects of extreme stress has a long history, primarily focused on the effects of war (e.g., shell shock in World War I) and of sexual assault against women. According to generally accepted criteria, diagnosis of PTSD requires exposure to a traumatic event that causes feelings of extreme fear, horror, or helplessness. Traumatic events are defined as experiences that involve death, serious injury, or threat of death. The consequences of this exposure are manifested in three symptom clusters required for diagnosis: involuntary reexperiencing of the trauma (e.g., nightmares, intrusive thoughts), avoidance of reminders and numbing of responsivity (e.g., not being able to have loving feelings), and increased arousal (e.g., difficulty sleeping or concentrating, hypervigilance, exaggerated startle response).

Because PTSD requires the presence of an external event and symptoms linked to this event, it differs from virtually all other psychiatric disorders and raises intriguing issues regarding the definition of trauma, the role of individuals' appraisal of and responses to the

event, the implications of a single versus repeated or ongoing exposure, and the role of community- and societal-level changes in attempting to prevent PTSD.

PREVALENCE

Results from a nationally representative study indicated that over the life course, 10% of women and 5% of men in the United States experience PTSD (Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995). Moreover, approximately half of adults have experienced a traumatic event. In a national survey of Vietnam veterans conducted in the late 1980s, Kulka et al. (1990) estimated that 31% of males and 26% of females in this population had PTSD from their military service. Because PTSD symptoms wax and wane, especially in response to subsequent life events (not necessarily traumatic ones), many people experience *partial PTSD*, or clinically significant symptoms of PTSD that do not meet the diagnostic criteria for the disorder. Including individuals with partial PTSD resulted in an estimate of roughly 830,000 Vietnam veterans with significant posttraumatic distress or impairment approximately 20 years after service (Weiss et al., 1992).

The disparity between the 50% prevalence of exposure to trauma and the 7% lifetime prevalence of PTSD means that individual responses to trauma vary dramatically. This variability sparks what appears to be the key question in the field: Why do some people, and not others, develop PTSD? This issue has been of particular interest in recent years, leading to a search for systematic risk factors. Central questions have focused on the correlates or predictors of who develops the disorder and the strength of these effects. Current conceptualizations of PTSD symptoms provide potential explanatory frameworks for appreciating how predictors may influence the stress response and lead to differential risk for PTSD.

MODELS OF TRAUMA RESPONSE

Models Focused on Cognitive and Emotional Processes

The two most influential cognitively oriented formulations of trauma response and recovery highlight either the importance of beliefs and linked emotions about the self and the world (McCann & Pearlman, 1990) or the network of associations linking thinking about or reminders of a traumatic event to cognitive, emotional, physiological, and behavioral responses (Foa & Rothbaum, 1989). In the former formulation, a traumatic event is conceptualized as shattering the

Address correspondence to Emily J. Ozer, UC-Berkeley School of Public Health, 140 Warren Hall, Berkeley, CA 94720-7360; e-mail: eozer@berkeley.edu.

previously held assumption that though the world is not always safe, the lack of safety affects other people only. Thus, the trauma victim's thinking about the world must be adapted to assimilate this shattered assumption and make sense of and integrate the event. The PTSD symptoms of intrusion and avoidance arise from this process, which is generally experienced as painful because it requires remembering the trauma and the accompanying distress. Recovery gradually occurs when this iterative process can be tolerated without avoidance or being overwhelmed emotionally. Thus, factors that reduce the likelihood of effective integration and assimilation would theoretically increase the likelihood of chronic stress-related symptoms and PTSD. These factors include characteristics of the individual, his or her environment, and the event itself.

In the latter cognitive formulation, the metaphor of a memory network is invoked to describe linked information about the traumatic event and subsequent cognitive, affective, physiological, and behavioral responses. Activation of one element in the network activates other aspects—almost always including fear—and this uninterrupted repetition accounts for the continuing symptoms. Recovery occurs if the strength of the associations among network components is reduced by a combination of desensitization and substitution of more adaptive associations.

Biologically Focused Models

Research on the biology of PTSD initially focused on studying psychophysiological arousal in the presence of reminders (sounds, images, or scripts) of the traumatic event. Results indicated that individuals with PTSD demonstrated heightened arousal and prolonged duration of arousal compared with control subjects (e.g., Keane et al., 1998). Recently, researchers investigating the biological substrates of PTSD have focused on the processes and structures of the brain. Research has centered on the amygdala and hippocampus, key brain areas involved in the fear response and in the consolidation of memory (e.g., LeDoux, 2000), as well as on the hypothalamic-pituitary-adrenal (HPA) axis, the parts of the neuroendocrine system that control reactions to acute stress.

Examination of parts of the brain involved in the fear response has been extensive because traumatic events usually generate fear, and because fear initiates the “flight or fight” physiological arousal associated with the hyperarousal symptoms of PTSD. Fear has also been implicated in the mechanisms establishing and maintaining traumatic memories. Research in animals has generally examined brain circuitry; research in humans has included neuroimaging studies of brain structures (Schuff et al., 1997) and processes (Rauch et al., 1996). New findings from animal studies have established direct neural pathways from sensory input to areas of the amygdala. In light of the known reciprocal neuronal connections between the hippocampus and amygdala, these findings suggest a powerful explanation for the automaticity of the fear response and the manner in which emotional memories occur and are transmitted to the hippocampus.

Careful study of individuals with PTSD indicates that they are characterized by an oversensitivity of the HPA axis. The HPA axis is involved in generating, maintaining, and shutting down increases in stress-related hormones in the face of danger, a central aspect of traumatic events. Evidence suggests that individuals with PTSD exhibit dysregulation in the activity of cortisol, a hormone regulated by the HPA axis. The destructive effects of the excessive production of cortisol are believed to be responsible for the atrophy of the hippocampus frequently found among individuals with chronic PTSD. The

dysregulation in the HPA axis involves the feedback loop that puts the brakes on the arousal generated by the perception of fear (Yehuda, 1997). These findings have generated research aimed at exploring the use of medications such as beta-blockers to dampen initial arousal. With initial arousal dampened, the consolidation of emotional memories may be attenuated. The hope, therefore, is that the reduction of physiological arousal immediately after the traumatic event will interfere with the processes that lead to the development of PTSD.

PREDICTORS OF PTSD

Two major meta-analyses (statistical analyses combining the results of many studies) of the predictors of PTSD have recently been published (Brewin, Andrews, & Valentine, 2000; Ozer, Best, Lipsey, & Weiss, 2003). These studies examined four categories of predictors: (a) historical or static characteristics such as family psychiatric history, intelligence, childhood trauma, and other previous trauma; (b) trauma severity; (c) psychological processes during and immediately after the trauma; and (d) social support and life stress after the traumatic event. Both meta-analyses showed that there were significant predictors of PTSD in all four categories, but that the strength of prediction varied across the categories. Those factors closer in time to the traumatic event (i.e., proximal factors) showed a stronger relationship to PTSD ($r \approx .40$) than did characteristics of the individual or his or her history that were more distant in time (i.e., distal factors; $r \approx .20$). The strongest predictor (included only in Ozer et al.) was peritraumatic dissociation. Peritraumatic dissociation refers to unusual experiences during and immediately after the traumatic event, such as a sense that things are not real, the experience of time stretching out, and an altered sense of self. Feeling that one is watching oneself in a movie or play as the event unfolds is a common description of the experience of dissociation. The strength of the relationship between such dissociation and likelihood of developing PTSD was in the moderate-to-large range.

Several important points regarding the predictors of PTSD should be highlighted. First, because largest correlations were about .40, peritraumatic dissociation and other predictors are neither necessary nor sufficient for developing PTSD. Second, the explanation for why peritraumatic dissociation is a predictor requires considering a host of differences in both the people exposed and the nature of the exposure. It may be that the severity of the traumatic event influences the likelihood of peritraumatic dissociation, either through the level of psychophysiological arousal the individual endures during the event or through more complicated relationships involving the effects of the individual's temperament, prior experience, prior psychological functioning, and other genetic or environmental factors that affect his or her capacity to regulate the emotional response. Third, level of social support following the trauma was also a strong predictor, with more social support associated with lower likelihood of later PTSD symptoms. An individual's level of social support likely relates to his or her history and functioning prior to the trauma, factors that this literature has generally not investigated and that meta-analytic approaches cannot easily summarize.

PROBLEMS AND POTENTIAL SOLUTIONS

The main limitation of the research on predictors of PTSD is the heavy reliance on self-report measures and retrospective designs. This natu-

realistic, retrospective approach makes sense considering the general unpredictability of exposure to trauma and the obvious ethical problems of exposing research participants to extreme stress in experimental or quasi-experimental designs. Prospective studies initiated prior to the occurrence of a major disaster or trauma, however, help address this limitation. For example, recent prospective research has assessed the psychological aftermath of the September 11 terrorist attacks in the United States (Silver, Holman, McIntosh, Poulin, & Gil-Rivas, 2002). Longitudinal research with individuals in high-risk jobs, such as jobs in the military, emergency services, and police force, also provides opportunities for prospective studies of possible predictors of PTSD.

Furthermore, the processes by which identified predictors may shape the development of PTSD remain largely unexamined. Systematic investigation of the ways in which these factors influence responses to trauma at multiple levels (e.g., behavioral, social, biological) could potentially inform interventions to attenuate or prevent PTSD. Future research should emphasize the more proximal mechanisms or processes—in psychological or physiological terms—that account for the relationship between PTSD symptoms and the more distal, static predictors such as prior trauma and family history of psychopathology. Evaluation of theory-based interventions with valid operationalization of critical variables could then provide data with which to evaluate current theory, an important area of study given the ethical prohibitions regarding experimental research in this field. Meta-analytic examination of the PTSD literature was useful in identifying simple, linear relationships between predictors and PTSD symptoms. It is likely, however, that some predictors influence each other in more complex ways; for example, a given predictor may strengthen the effects of another predictor on the development of PTSD (moderation) or may serve as the mechanism through which another predictor increases the likelihood of developing PTSD (mediation). Moreover, the unique meaning of exposure for a single individual may provide the most parsimonious explanation for why a person develops PTSD.

INTRIGUING ISSUES AND QUESTIONS

Definition of Traumatic Event

The definition of what constitutes a traumatic event is central to the diagnosis of PTSD and to all research regarding the disorder. Defining a traumatic event, however, is not simple; indeed, the diagnostic definition has changed over the past decade. Definitional issues raise interesting challenges for PTSD research as they call into question what kinds of experiences are traumatic and for whom. If two people experience the same event (e.g., encountering body parts) but only one reacts with fear, helplessness, or horror, has only one of them experienced a traumatic event?

Because traumatic events typically involve immediate horror and threat to survival (e.g., sexual assault at knifepoint, torture, combat), very high physiological arousal usually accompanies the experience. A broadening of the types of events that some people consider to be traumatic has led to inclusion in the PTSD literature of studies of highly distressing events (e.g., receiving a diagnosis of cancer) that may or may not invoke the same arousal that acute life-threatening situations do. The presence or absence of arousal may well become a key phenomenon that has implications for symptoms of PTSD and whether or not an event is deemed traumatic. If the subjective emotional and physiological response to the event is overlooked, research

may not yield consistent findings that would perhaps emerge if arousal were required to identify an event as traumatic.

Ongoing Exposures and the Prototype of PTSD Symptoms

Early theories of trauma response and PTSD were largely based on individuals who lived in generally positive environments and experienced a discrete traumatic event or series of events within a discrete period of time (e.g., sexual assault, disaster, military service), so that the traumatic event or events signified a dramatic disruption of pre-trauma life. It is unclear how well this model fits the experience of individuals subjected to pervasive traumatic stress, for example, in the contexts of chronic physical or sexual abuse, deadly civilian conflicts and genocide, or severe community violence in low-income urban areas. The impairments of such individuals, including problems in interpersonal relationships and affect and impulse regulation, may be complicated and difficult to treat (Herman, 1992). The self-perceptions of people who have experienced ongoing trauma seem to be dramatically worse than those of individuals who have experienced discrete traumatic events in the context of otherwise normal development. Some researchers have suggested that a separate term, such as “complex PTSD” or “disorders of extreme stress—not otherwise specified,” should be used in place of PTSD to better describe this disorder. Much prior research did not examine whether the predictors of disorder differ depending on whether trauma is experienced as a discrete event or as an ongoing condition of life. Future research that investigates this distinction may find clearer patterns of predictive relationships than have been uncovered so far.

Prevention of PTSD

What are the implications of the research on predictors of PTSD for the prevention of the disorder? Secondary-prevention efforts that seek to reduce the likelihood of PTSD among individuals who have recently been exposed to traumatic stress could utilize these findings by developing early-intervention models that target processes associated with PTSD risk in the meta-analyses reviewed here (e.g., social support, peritraumatic dissociation if the affected individuals could be seen immediately following the event). Strategies for the primary prevention of PTSD would entail reducing the incidence of traumatic events. The most frequent types of traumatic events studied in the research literature have been combat exposure, interpersonal assaults, accidents, and disasters. Although some traumatic stressors, such as earthquakes, are beyond human control, action at the individual and community levels could clearly reduce the risk of exposure to many forms of traumatic stress and also shape the impact of even uncontrollable traumatic stressors on populations. Indeed, such efforts form the backbone of diverse disciplines and public-health policy efforts in areas including building and transportation safety, community violence prevention, domestic violence prevention, and international diplomacy.

There have been numerous investigations of the prevalence of PTSD in diverse communities that have experienced armed civil conflict or war, political repression, or other chronic violence. In such settings of collective trauma, it is particularly critical to look beyond the individual when considering both the effects of trauma and strategies for intervention and prevention. For example, severe political repression affects not just individuals but also the social

institutions and norms of a nation or community (Martin-Baro, 1994). Virtually all interventions for PTSD focus on the individual with symptoms and utilize medication or psychotherapy. Although these interventions may help alleviate individual symptoms, they are obviously inadequate for addressing the harm to social institutions or promoting long-term healing and mental health if the sources of persistent trauma are not addressed. When PTSD is a consequence of collective social and political conditions, primary prevention of this disorder involves social and political changes in the community or nation, as does repair of the social fabric. Thus, perhaps more than any other psychological disorder, PTSD forces consideration of advocacy and political action as primary (universal) prevention tools.

Recommended Reading

- Brewin, C.R., Andrews, B., & Valentine, J.D. (2000). (See References)
- McNally, R.J. (2003). Progress and controversy in the study of posttraumatic stress disorder. *Annual Review of Psychology, 54*, 229–252.
- Ozer, E.J., Best, S.R., Lipsey, T.L., & Weiss, D.S. (2003). (See References)
- Wilson, J.P., Friedman, M.J., & Lindy, J.D. (Eds.). (2001). *Treating psychological trauma and PTSD*. New York: Guilford Press.
-

REFERENCES

- Brewin, C.R., Andrews, B., & Valentine, J.D. (2000). Meta-analysis of risk factors for posttraumatic stress disorder in trauma-exposed adults. *Journal of Consulting and Clinical Psychology, 68*, 748–766.
- Foa, E.B., & Rothbaum, B.O. (1989). Behavioral-cognitive conceptualizations of posttraumatic stress disorder. *Behavior Therapy, 20*, 155–176.
- Herman, J. (1992). Complex PTSD. *Journal of Traumatic Stress, 5*, 377–391.
- Keane, T.M., Kolb, L.C., Kaloupek, D.G., Orr, S.P., Blanchard, E.B., Thomas, R.G., Hsieh, F.Y., & Lavori, P.W. (1998). Utility of psychophysiological measurement in the diagnosis of posttraumatic stress disorder: Results from a Department of Veterans Affairs cooperative study. *Journal of Consulting and Clinical Psychology, 66*, 914–923.
- Kessler, R.C., Sonnega, A., Bromet, E., Hughes, M., & Nelson, C.B. (1995). Posttraumatic stress disorder in the National Comorbidity Survey. *Archives of General Psychiatry, 52*, 1048–1060.
- Kulka, R.A., Schlenger, W.E., Fairbank, J.A., Hough, R.L., Jordan, B.K., Marmar, C.R., & Weiss, D.S. (1990). *Trauma and the Vietnam war generation: Report of the findings from the National Vietnam Veterans Readjustment Study*. New York: Brunner/Mazel.
- LeDoux, J.E. (2000). Emotion circuits in the brain. *Annual Review of Neuroscience, 23*, 155–184.
- Martin-Baro, I. (1994). *Writings for a liberation psychology* (A. Aron & S. Corne, Eds.). Cambridge, MA: Harvard University Press.
- McCann, I.L., & Pearlman, L.A. (1990). *Psychological trauma and the adult survivor*. New York: Brunner/Mazel.
- Ozer, E.J., Best, S.R., Lipsey, T.L., & Weiss, D.S. (2003). Predictors of posttraumatic stress disorder and symptoms in adults: A meta-analysis. *Psychological Bulletin, 129*, 52–73.
- Rauch, S.L., van der Kolk, B., Fisler, R.E., Alpert, N.M., Orr, S.P., Savage, C.R., Fischman, A.J., Jenike, M.A., & Pitman, R.K. (1996). A symptom provocation study of posttraumatic stress disorder using positron emission tomography and script-driven imagery. *Archives of General Psychiatry, 53*, 380–387.
- Schuff, N., Marmar, C.R., Weiss, D.S., Neylan, T.C., Schoenfeld, F.B., Fein, G., & Weiner, M.W. (1997). Reduced hippocampal volume and n-acetyl aspartate in posttraumatic stress disorder. *Annals of the New York Academy of Sciences, 821*, 516–520.
- Silver, R.C., Holman, E.A., McIntosh, D.N., Poulin, M., & Gil-Rivas, V. (2002). National Longitudinal Study of Psychological Responses to September 11. *Journal of the American Medical Association, 288*, 1235–1244.
- Weiss, D.S., Marmar, C.R., Schlenger, W.E., Fairbank, J.A., Jordan, B.K., Hough, R.L., & Kulka, R.A. (1992). The prevalence of lifetime and partial post-traumatic stress disorder in Vietnam Theatre veterans. *Journal of Traumatic Stress, 5*, 365–376.
- Yehuda, R. (1998). Psychoneuroendocrinology of post-traumatic stress disorder. *Psychiatric Clinics of North America, 21*, 359–379.

Math Anxiety: Personal, Educational, and Cognitive Consequences

Mark H. Ashcraft¹

Department of Psychology, Cleveland State University, Cleveland, Ohio

Abstract

Highly math-anxious individuals are characterized by a strong tendency to avoid math, which ultimately undercuts their math competence and forecloses important career paths. But timed, on-line tests reveal math-anxiety effects on whole-number arithmetic problems (e.g., $46 + 27$), whereas achievement tests show no competence differences. Math anxiety disrupts cognitive processing by compromising ongoing activity in working memory. Although the causes of math anxiety are undetermined, some teaching styles are implicated as risk factors. We need research on the origins of math anxiety and on its "signature" in brain activity, to examine both its emotional and its cognitive components.

Keywords

anxiety; mental arithmetic; math competence; working memory; problem solving

My graduate assistant recently told me about a participant he had tested in the lab. She exhibited increasing discomfort and nervousness as the testing session progressed, eventually becoming so distraught that she burst into tears. My assistant remarked that many of our participants show some unease or apprehension during testing—trembling hands, nervous

laughter, and so forth. Many ask, defensively, if their performance says anything about their overall intelligence. These occasionally extreme emotional reactions are not triggered by deliberately provocative procedures—there are no personally sensitive questions or intentional manipulations of stress. Instead, we merely ask college adults to solve elementary-school arithmetic problems, such as $46 + 18 = ?$ and $34 - 19 = ?$

The reactions are obvious symptoms of anxiety, in this case math anxiety induced by ordinary arithmetic problems presented in timed tasks. On the one hand, it is almost unbelievable that tests on such fundamental topics can be so upsetting; knowing that $15 - 8 = 7$ ought to be as basic as knowing how to spell "cat." On the other hand, U.S. culture abounds with attitudes that foster math anxiety: Math is thought to be inherently difficult (as Barbie dolls used to say, "Math class is hard"), aptitude is considered far more important than effort (Geary, 1994, chap. 7), and being good at math is considered relatively unimportant, or even optional.

In this article, I discuss what has been learned about math anxiety across the past 30 years or so, and suggest some pressing issues to be pursued in this area. An important backdrop for this discussion is the fact that modern society is increasingly data and technology oriented, but the formal educational system seems increasingly unsuccessful at educating students to an adequate level of "numeracy," the

mathematical equivalent of literacy (Paulos, 1988).

MATH ANXIETY DEFINED AND MEASURED

Math anxiety is commonly defined as a feeling of tension, apprehension, or fear that interferes with math performance. The first systematic instrument for assessing math anxiety was the Mathematics Anxiety Rating Scale (MARS), published by Richardson and Suinn (1972). In this test, participants rate themselves on the level of anxiety they would feel in various everyday situations, such as trying to refigure a restaurant bill when they think they have been overcharged or taking a math test. My co-workers and I use a shortened version of the test, which yields scores that correlate well with scores obtained using the original test and also has very acceptable test-retest reliability (i.e., an individual who takes the test on different occasions generally receives similar scores). We have also found that for a quick determination, one can merely ask, "On a scale from 1 to 10, how math anxious are you?" Across at least a half-dozen samples, responses to this one question have correlated anywhere from .49 to .85 with scores on the shortened MARS.

There is a rather extensive literature on the personal and educational consequences of math anxiety, summarized thoroughly in Hembree (1990). Perhaps the most pervasive—and unfortunate—tendency is avoidance. Highly math-anxious individuals avoid math. They take fewer elective math courses, both in high school and in college, than people with low math anxiety. And when they take math, they receive lower grades. Highly math-anxious people also espouse negative attitudes toward math, and hold negative self-perceptions

Does Drinking Promote Risky Sexual Behavior?

A Complex Answer to a Simple Question

M. Lynne Cooper

University of Missouri–Columbia

ABSTRACT—*The present review argues that, popular lore notwithstanding, the well-documented association between usual patterns of alcohol use and risky sex reflects multiple underlying processes that are both causal and noncausal (spurious) in nature. It is further argued that even alcohol's acute causal effects on sexual behavior are more variable than they are commonly assumed to be. Drinking can promote, inhibit, or have no effect on behavior, depending on the interplay of factors governing behavior in a particular situation and the content of individually held beliefs about alcohol's effects.*

KEYWORDS—*alcohol; risky sex; condom use*

With the advent of AIDS, efforts to understand the causes of sexual risk-taking have assumed great urgency. In this context, alcohol and its potential disinhibiting effects have received much attention. In the past 20 years, more than 600 studies have been conducted on the link between drinking and risky sex, and drinking proximal to intercourse has become a standard target of intervention efforts aimed at reducing risky sexual behaviors. Targeting drinking as part of a strategy to reduce risky sex can only be effective if drinking causally promotes such behaviors, however. Does the evidence support this connection? Conventional wisdom aside, the answer to this question is surprisingly complex.

BACKGROUND

The belief that alcohol causally disinhibits sexual behavior is firmly ingrained in our culture. Most people believe that drinking increases the likelihood of sexual activity, enhances sexual experience, and promotes riskier sexual behavior. Many

also attribute risky sexual experiences to the fact that they were drinking and report drinking (or plying their partner with alcohol) to exploit alcohol's alleged disinhibiting effects on sexual behavior.

Consistent with popular belief, the overwhelming majority of studies do find an association between the two behaviors (Cooper, 2002; Leigh & Stall, 1993). The typical study examines the cross-sectional association between usual patterns of drinking and risky sex. For example, in such studies, individuals who drink consistently report more partners than those who abstain do. Owing to design limitations, however, these studies tell us little about the underlying causal relationship. Such data cannot even establish a temporal link between drinking and risky sex, a minimum condition for attributing causality to acute alcohol effects. Thus, although people are quick to infer a causal connection between the two behaviors, multiple interpretations are possible. Three will be considered here.

THIRD-VARIABLE EXPLANATIONS

Third variable explanations that involve stable (possibly genetically based) features of the individual or of his or her life situation offer one important explanation. For example, a person might both drink and have risky sex to satisfy sensation-seeking needs, because of poor impulse control or coping skills, or in an effort to cope with negative emotions. Consistent with this possibility, Cooper, Wood, Orcutt, and Albino (2003) showed that one third of the statistical overlap (modeled by a higher-order factor) among diverse risk behaviors, including alcohol use and risky sex, could be explained by low impulse control and an avoidant style of coping with negative emotions. Thrill seeking accounted for a much smaller proportion of the overlap, and significantly predicted the overlap only among white (not black) adolescents. In addition, avoidance coping predicted the onset of drinking among initially abstinent youth, and in interaction with impulsivity it predicted the onset of sexual

Address correspondence to M. Lynne Cooper, 105 McAlester Hall, University of Missouri, Columbia, MO, 65211; e-mail: cooperm@missouri.edu.

behavior among those who were initially virgins. Thus, avoidance coping and impulsivity appear to be important common causes that partially account for the link between drinking and risky sex. Although thrill seeking was not a strong predictor in our randomly constituted, biracial adolescent sample, closely related measures (e.g., sensation seeking) have been shown to fully account for the association between drinking and risky sex in some high-risk samples (e.g., heavy drinkers, gay or bisexual men).

An individual might also drink and have risky sex as part of a lifestyle, such as being single or living in a fraternity house, where both behaviors are tacitly or explicitly encouraged. Consistent with this possibility, perceptions of peer norms related to drinking and sex are among the most robust predictors of involvement in both behaviors among youth. Similarly, characteristics of one's home environment—e.g., living in a single-parent or conflict-ridden household—have also been found to predict both behaviors. Thus, direct evidence showing that covariation between the two behaviors can be explained by third variables, and indirect evidence showing that involvement in both behaviors is linked to the same putative causal factors, support the contention that the association between drinking and risky sex is at least partly due to the influence of underlying common causes.

REVERSE CAUSAL EXPLANATIONS

Reverse causal explanations posit that the intention or desire to engage in risky sex causes one to drink when sexual opportunity is perceived. Consistent with this possibility, surveys of college students reveal that up to one half of undergraduates report drinking more than usual to make it easier to have sex and giving their partners alcohol to increase the likelihood of sex (Cooper, 2002). Alternatively, an individual might plan a romantic evening and drink to enhance that experience or plan to pick someone up at a party and drink to provide an excuse (to oneself or others) for behavior that might later be seen as inappropriate. Although different motives (to disinhibit, enhance, or excuse) presumably underlie drinking in each scenario, all accounts nevertheless assume that people who drink strategically hold relevant beliefs about alcohol's capacity to facilitate the desired sexual outcome. Supporting this notion, Dermen and I (Dermen & Cooper, 1994) found that people who believe that alcohol enhances or disinhibits sex are more likely to drink, and to drink to intoxication, in sexual or potentially sexual situations (e.g., on a date). Thus, for at least some people, the intention or desire to have sex may precede and cause drinking, rather than the reverse.

CAUSAL EXPLANATIONS

Two prominent theories depict alcohol as a cause of disinhibited social behaviors: alcohol myopia and expectancy theories. Al-

cohol-myopia theory (Steele & Josephs, 1990) posits that disinhibited behavior results from an interaction of diminished cognitive capabilities and the specific cues that influence behavior in a given situation. Because alcohol narrows the range of cues perceived and limits the ability to process and extract meaning from these cues, intoxication renders a person susceptible to momentary pressures. Simple, highly salient cues (e.g., sexual arousal) continue to be processed, whereas more distal, complex ones (e.g., fear of pregnancy) are no longer adequately processed. Consequently, alcohol creates a "myopia" in which incompletely processed aspects of immediate experience exert undue influence on behavior and emotion. Accordingly, alcohol has its strongest effect when a behavior is controlled by instigating and inhibiting cues that are strong and nearly equal in force—a circumstance known as inhibition conflict.

In support of this model, Steele and Josephs conducted a meta-analysis (a method for statistically combining effects) of 34 experimental studies testing alcohol's effects on social behavior. Results revealed a small (.14) average standardized effect for alcohol under low-inhibition-conflict conditions versus a large effect (1.06) under high-conflict conditions. Thus, consistent with alcohol-myopia theory, intoxicated participants behaved more extremely than sober ones did primarily under high-conflict conditions.

Whereas alcohol-myopia theory emphasizes pharmacological mechanisms, expectancy theory emphasizes psychological ones. According to this view, an individual's behavior after drinking is driven by pre-existing beliefs (expectancies) about alcohol's effects on behavior, much like a self-fulfilling prophecy (Hull & Bond, 1986). The role of expectancies has been investigated experimentally in studies that independently manipulate alcohol content and expectancy set (the belief that alcohol has been consumed). In a meta-analysis of 36 such studies, Hull and Bond found that people who believed they had consumed alcohol (but had not) behaved similarly to those who had consumed alcohol (and didn't know it). Indeed, expectancy effects were significant and only slightly smaller than alcohol-content effects (.27 vs. .35). Expectancy theory thus highlights the role of individually held beliefs about alcohol's effects, and suggests by extension that alcohol effects on behavior may vary as a function of these beliefs.

The foregoing indicates that alcohol intoxication can cause more extreme social behavior through both pharmacological and psychological mechanisms. Contrary to popular opinion, these effects are not immutable, but are contingent on the nature of instigating and inhibiting cues governing momentary behavior, on the content of one's beliefs about alcohol effects, or possibly on a combination of both. Theoretically, then, alcohol intoxication should lead to riskier sexual behavior only under certain conditions or among certain people, a contention that existing evidence largely supports.

A SELECTIVE REVIEW OF NATURALISTIC STUDIES OF DRINKING AND RISKY SEX

From a public health perspective, one of the most important issues concerns alcohol's potential to facilitate the occurrence of intercourse, especially with new or casual partners. To investigate this issue, Orcutt and I (Cooper & Orcutt, 1997) examined the link between drinking and intercourse on two first-date occasions in a large, representative sample of adolescents. Although these data are correlational, the within-subjects design allowed us to compare a person's behavior on two occasions that, for many, differed in the presence versus absence of alcohol, thus helping us rule out stable individual differences between drinkers and nondrinkers as an alternative explanation for observed differences in sexual behavior. As Figure 1 illustrates, our results showed that rates of intercourse were higher when the male partner drank and lower when he abstained. Interestingly, however, parallel analyses revealed no such relationship for drinking by the female partner.

Drawing on alcohol-myopia theory, we reasoned that the psychological conditions necessary for alcohol-related disinhibition existed only among men. Specifically, if males experienced a type of conflict in which dominant cues favored behavioral action while peripheral cues favored behavioral inhibition, we would expect (due to the greater difficulty of accessing and processing peripheral cues) alcohol-related disinhibition. In contrast, if females experienced a type of conflict in which dominant cues favored inhibition and peripheral ones activation, then decreased processing of peripheral cues should not disinhibit behavior. Consistent with this logic, we found that men perceived more benefits relative to costs of having sex on their most recent first date, whereas women perceived more costs relative to benefits. Moreover, only the per-

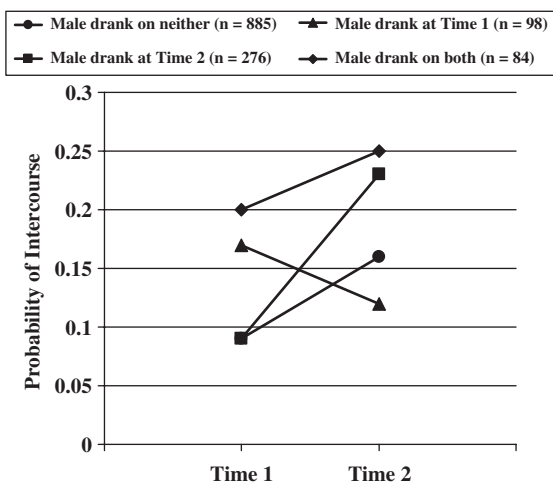


Fig. 1. Male couple-member alcohol use and probability of intercourse on two first-date occasions. From Cooper & Orcutt (1997).

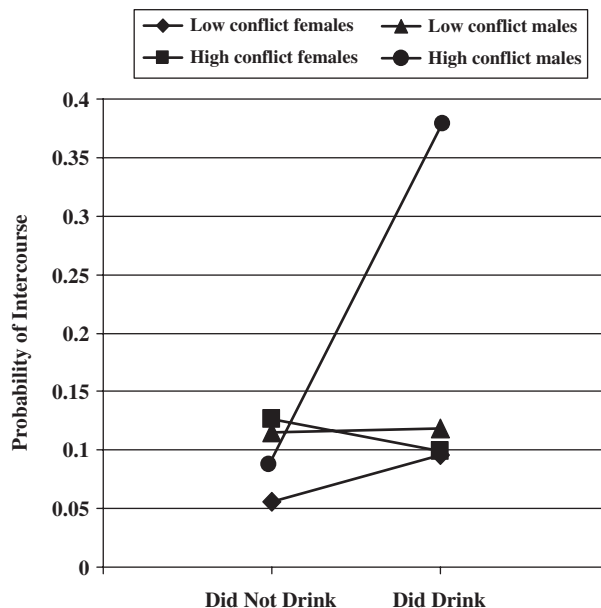


Fig. 2. Alcohol use, gender, and perceived conflict predicting probability of intercourse on the most recent first date. From Cooper & Orcutt (1997).

ception of increasing costs predicted conflict among men (for whom benefits were more salient), whereas the reverse was true among women. Thus, men and women appeared to experience qualitatively different forms of conflict about having sex on their most recent first date. Moreover, consistent with the idea that the type of conflict conducive to alcohol-related disinhibition occurred only among men, rates of intercourse on the date were significantly elevated only among highly conflicted men who drank alcohol (Fig. 2).

Together these data indicate that how alcohol affects sexual behavior is determined by the content and relative strength of competing cues that inhibit or activate behavior, and they raise the possibility that alcohol might even promote safer behavior under the right circumstances! Recent experimental evidence lends strong support to this idea, showing that when the potential costs of having sex with an attractive new partner were made salient, intoxicated individuals reported more cautious intentions than did sober ones (MacDonald, Fong, Zanna, & Martineau, 2000).

A second key question from a public health perspective is whether drinking reduces condom use. Somewhat surprisingly, most naturalistic studies directly testing the link between drinking on a specific intercourse occasion and condom use on that occasion find no relationship. Indeed in a quantitative analysis of 29 such tests (Cooper, 2002), alcohol was associated with lower rates of condom (and birth-control) use only under circumscribed conditions: at first intercourse but not on subsequent intercourse occasions, in younger but not older samples, and in studies conducted earlier rather than more recently (Leigh, 2002, reports similar results).

One plausible interpretation of these findings is that few people experience the type of conflict conducive to alcohol-related disinhibition of condom use, though such conflict may have been common in the past and may still be common among sexually inexperienced, younger adolescents. Although no study has directly tested these ideas, a study conducted by Dermen and me (Dermen & Cooper, 2000) provides indirect support. We examined feelings of conflict about using a condom on four occasions of intercourse across two different samples (one of college students; one of community-residing young adults, aged 19–25), and found that fewer than 15% of participants were highly conflicted about using a condom on each occasion. Moreover, although drinking did not predict lower overall rates of condom use on any of these occasions, it predicted significantly lower rates (in three of four tests) among those who felt conflicted about using a condom on that occasion.

In short, these data suggest that drinking can undermine safe sex behaviors, but that it does not invariably do so. Rather, alcohol can promote, inhibit, or have no effect on risky sexual behaviors depending on the specific constellation of salient cues in the moment.

THE ROLE OF ALCOHOL EXPECTANCIES

Although the preponderance of evidence suggests that inhibition conflict plays the larger role in accounting for alcohol's acute causal effects on risky sexual behavior, expectancies also appear important. As previously discussed, those who believe that alcohol disinhibits or enhances sexual experience are more likely to drink in (potentially) sexual situations, suggesting that expectancies are instrumental in setting up situations that may lead to alcohol-related disinhibition of sex. Expectancies (in the absence of alcohol) have also been shown to influence other aspects of sexual experience that could indirectly promote risky behaviors. For example, a recently conducted experiment in which participants were paired with previously unknown, opposite-sex partners found that participants who thought they had consumed alcohol (though none had been consumed) reported greater sexual arousal, perceived their partners as more sexually disinhibited, and showed erotic slides (presumed to be a behavioral analog of sexual interest) to their partners significantly longer, but only if they also held strong beliefs about alcohol's capacity to disinhibit or enhance sexual experience (George, Stoner, Norris, Lopez, & Lehman, 2000). These data suggest that expectancies, once activated by alcohol consumption, may strengthen instigating cues for sex, thereby bringing an individual for whom costs might otherwise greatly outweigh benefits into a state of high inhibition conflict. Finally, expectancies have also been shown to interact with feelings of conflict to jointly predict alcohol-related disinhibition of risky sexual behavior (Dermen & Cooper, 2000). Thus, expectancies and actual alcohol content might work in tandem to disinhibit risky sexual behavior in real-world situations where the two processes always co-occur.

CONCLUSIONS AND FUTURE DIRECTIONS

The relationship between alcohol use and risky sex is complex. It cannot be explained by a single mechanism, but instead reflects multiple underlying causal and noncausal processes. Moreover, even the causal portion of this relationship is not manifest as a main effect but as an interaction.

These complexities have important implications for both research and intervention efforts. The multiplicity of plausible causal mechanisms highlights the need for diverse methodological approaches for exploring alternative models, and for greater sophistication in framing research questions. Rather than focusing on which model better accounts for the link between drinking and risky sex, future research should focus on delineating the conditions under which, and the individuals for whom, different causal (and noncausal) processes are most likely to operate.

At the same time, researchers trying to unravel alcohol's acute effects must adopt more sophisticated methods for studying the complex interplay between drinking, individually held expectancies, and situational cues. Diary methods in which people report on both behaviors across multiple days provide an important and ecologically valid approach for examining this relationship. Such methods not only enable more accurate assessment of the behaviors themselves but also provide a window onto the motivations, emotions, and cognitions that subtly shape these behaviors and set the stage for alcohol's variable effects across individuals and situations.

The existence of multiple causal models also points to the need for diverse intervention strategies, and raises the possibility that different strategies will be optimally effective among individuals for whom different causal processes dominate. For example, among people who chronically drink and engage in risky behaviors, the relationship between drinking and risky sex may primarily reflect the influence of underlying common causes. For such individuals, universal change strategies targeting these common causes should be maximally efficacious. Alternatively, carefully designed interventions aimed at reducing drinking (or manipulating risk cues) in settings where drinking and encountering potential partners co-occur (e.g., college bars) could lower sexual risks associated with alcohol use among those who are most vulnerable to acute intoxication effects, situational influences, or both. To be maximally effective, interventions must be carefully tailored for different populations and circumstances in which different underlying causal processes predominate.

Recommended Reading

Cooper, M.L. (2002). (See References)

George, W.H., & Stoner, S.A. (2000). Understanding acute alcohol effects on sexual behavior. *Annual Review of Sex Research, 11*, 92–122.

Leigh, B.C., & Stall, R. (1993). (See References)

Weinhardt, L.S., & Carey, M.P. (2000). Does alcohol lead to sexual risk behavior? Findings from event-level research. *Annual Review of Sex Research, 11*, 125–157.

REFERENCES

- Cooper, M.L. (2002). Alcohol use and risky sexual behavior among college students and youth. *Journal of Studies on Alcohol, 14*(Suppl.), 101–117.
- Cooper, M.L., & Orcutt, H.K. (1997). Drinking and sexual experiences on first dates among adolescents. *Journal of Abnormal Psychology, 106*, 191–202.
- Cooper, M.L., Wood, P.K., Orcutt, H.K., & Albino, A.W. (2003). Personality and predisposition to engage in risky or problem behaviors during adolescence. *Journal of Personality and Social Psychology, 84*, 390–410.
- Dermen, K.H., & Cooper, M.L. (1994). Sex-related alcohol expectancies among adolescents. *Psychology of Addictive Behaviors, 8*, 161–168.
- Dermen, K.H., & Cooper, M.L. (2000). Inhibition conflict and alcohol expectancy as moderators of alcohol's relationship to condom use. *Experimental and Clinical Psychopharmacology, 8*, 198–206.
- George, W.H., Stoner, S.A., Norris, J., Lopez, P.A., & Lehman, G.L. (2000). Alcohol expectancies and sexuality: A self-fulfilling prophecy analysis of dyadic perceptions and behavior. *Journal of Studies on Alcohol, 61*, 168–176.
- Hull, J.G., & Bond, C.F. (1986). Social and behavioral consequences of alcohol consumption and expectancy: A meta-analysis. *Psychological Bulletin, 99*, 347–360.
- Leigh, B.C. (2002). Alcohol and condom use: A meta-analysis of event-level studies. *Sexually Transmitted Disease, 29*, 476–482.
- Leigh, B.C., & Stall, R. (1993). Substance use and risky sexual behavior for exposure to HIV: Issues in methodology. *American Psychologist, 48*, 1035–1045.
- MacDonald, T.K., Fong, G.T., Zanna, M.P., & Martineau, A.M. (2000). Alcohol myopia and condom use: Can alcohol intoxication be associated with more prudent behavior? *Journal of Personality and Social Psychology, 78*, 605–619.
- Steele, C.M., & Josephs, R.A. (1990). Alcohol myopia: Its prized and dangerous effects. *American Psychologist, 45*, 921–932.

When Photographs Create False Memories

Maryanne Garry and Matthew P. Gerrie

Victoria University of Wellington, Wellington, New Zealand

ABSTRACT—*Photographs help people illustrate the stories of their lives and the significant stories of their society. However, photographs can do more than illustrate events; in this article, we show that photographs can distort memory for them. We describe the course of our “false-memory implantation” research, and review recent work showing that photographs can sometimes increase—while other times decrease—false memories. First, we discuss research showing that a doctored photo, showing subjects taking a completely fictitious hot-air-balloon ride, can cultivate false memories for that experience. We hypothesize that the photograph helps subjects to imagine details about the event that they later confuse with reality. Second, we show that although photographs are indeed powerful sources of influence on memory, they are not necessarily as powerful as narrative. In fact, in certain circumstances, photographs might constrain imagination. Third, we discuss research showing that true photographs can also cultivate false memories. Finally, we present recent work showing that photographs can create false memories for current events.*

KEYWORDS—*memories; false memories; photographs*

Memory is the way we keep telling ourselves our stories, said the writer Alice Munro. People tell their stories in words and pictures; they write letters, pull out childhood photo albums at family reunions, and talk about what happened when, where, and to whom. Sometimes people are told stories by others—socially significant, newsworthy stories in the paper or on television. Whether they are the stories of individual lives or of society as a whole, important stories are often illustrated with photographs, which give the imprimatur of authenticity. In this paper, we review the research showing that photographs can create false stories. Photographs can distort memory.

Address correspondence to Maryanne Garry, Victoria University of Wellington, School of Psychology, Box 600, Wellington, New Zealand, 6005; e-mail: maryanne.garry@vuw.ac.nz.

A decade ago, Loftus and Pickrell (1995) showed how easily people can be led to remember wholly false events. They asked subjects to read stories of some childhood events, one of which described each subject getting lost in a shopping mall. That event was false, but by the end of the study, 25% of subjects falsely remembered at least some details about it. In the scientific community, the paradigm has proven both popular and powerful, with nine similar narrative-based studies showing a mean false recall of 33% (see Garry & Wade, 2005, for a brief review).

Considered as a whole, research using this “lost in the mall” paradigm shows us how easy it is to implant false memories using remarkably simple technology. Yet we live in a world of increasingly sophisticated technology. For example, not so long ago, only Hollywood studios and advertising agencies had the skill and the equipment to doctor photographs. These days, it seems that everyone has a digital camera and image-editing software. While it may seem like harmless fun to airbrush an annoying ex out of a photo or to cobble together a photo of little Theo meeting his favorite action figure, recent evidence suggests that doctored photos can doctor memory, too.

FALSE PHOTOGRAPHS AND FALSE MEMORIES

“It isn’t trustworthy simply because it’s a picture,” the photographer Pedro Meyer told *Wired* magazine. “It is trustworthy if someone we trust made it” (Rosenberg, 1995, p. 171). Meyer is right, of course—yet people do trust photos. People think they reliably capture the past. Yes, they may know that photographs can be doctored, and they may not trust the famous, allegedly doctored photo of Lee Harvey Oswald holding a rifle in his backyard,¹ but they still think their personal photographs are real. What might be the power of a doctored childhood photograph on memory?

To answer this question, Wade, Garry, Read, and Lindsay (2002) adapted the Loftus and Pickrell (1995) “Lost in the mall”

¹This photograph is widely available on the Internet; for example, at John McAdams’ JFK Assassination Home Page: <http://mcadams.posc.mu.edu/photos.jpg>

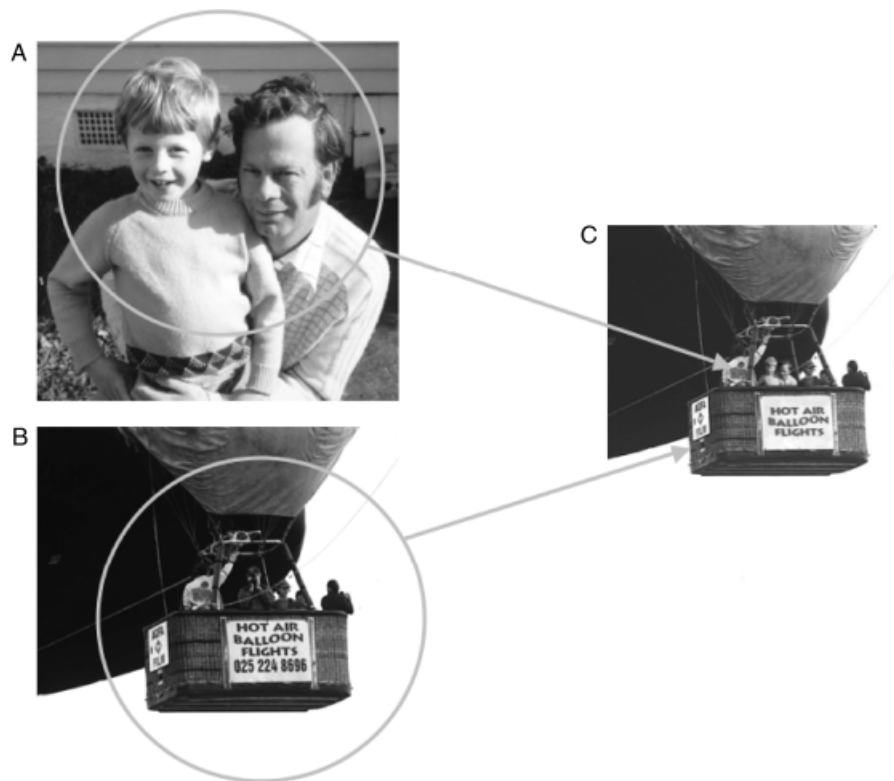


Fig. 1. Demonstration of the doctoring process as used in Wade et al. (2002). Subjects are “cut” from an original photo (A) and “pasted” into a dummy balloon photo (B). Subjects are shown the false photo (C) and asked how much they remember about the event over three interviews.

method, but replaced narratives with photographs. The question was simply whether showing subjects a doctored photograph—with no supporting narrative—would lead them to remember a false experience. They showed each subject four photos: Three were real childhood photos and one was fake, showing the subject taking a childhood hot-air-balloon ride. The doctored photos were created for each subject by using Photoshop and an assortment of additional childhood photos. Wade et al. “cut” the subjects and at least one family member out of these additional photos and “pasted” them into a dummy photo of a hot-air-balloon ride (see Fig. 1). Family-members verified that the balloon ride never happened. After subjects reviewed each photo three times over a maximum of 2 weeks, 50% remembered something about the ride. Often these reports were rich with detail, and at the end of the study, subjects tended to express genuine astonishment when they learned the photo was a fake.

Wade et al. (2002) speculated that photographs might give subjects some kind of cognitive “springboard,” allowing them to generate thoughts, feelings, details, images—the hallmarks of genuine memories—more easily than is possible than with verbal descriptions. Subjects confused these mental products for genuine experience, a process called *source confusion* (Johnson, Hashtroudi, & Lindsay, 1993). In fact, the comparatively high rate of false recall led them to wonder which medium is better at cultivating false memories: photos or narratives? To answer this

question, Garry and Wade (2005) combined the methods of Loftus and Pickrell (1995) and Wade et al. (2002) such that half the subjects saw a photograph of themselves taking a balloon ride while the other half read a description of the same false event. To make sure the description and the photo conveyed the same information, other researchers were asked to extract all the information they could from the balloon photo and use that information to create the narrative. By interview three, 80% of the subjects who read a false narrative reported memories of the event, compared to 50% of those subjects who saw a false photo. Moreover, when subjects were asked whether photographs or narratives were better at “jogging” their memories during the study, there was an interesting interaction: Narrative subjects said that photos were better memory joggers, while photo subjects said that narratives were better memory joggers.

Taken together, these studies suggest that photos alone are powerful enough to elicit false memories on their own but that they are not necessarily more powerful than narratives. In fact, they might be less powerful than narratives. If, as Wade et al. (2002) hypothesized, photographs do make it easier for people to imagine—and then come to believe—the false event depicted, then how do we account for Garry and Wade’s (2005) finding that narratives actually elicited more false memories than photographs? The answer may lie in the fact that the photo provided a concrete visual depiction of the balloon ride, making it more

difficult for subjects to construct information about the trip. While narratives allowed subjects to generate their own details about their balloons, the detail in the false photographs demanded that subjects generate details about the experimenters' balloon. Thus, subjects who saw the photograph would have found it more difficult to produce information they later might take to be a real memory.

TRUE PHOTOGRAPHS AND FALSE MEMORIES

The fact that doctored photographs can elicit false memories does not help explain situations in which there is no real attempt to mislead. For example, it does not say much about whether there are dangers in looking at real family photos. However, a common psychotherapeutic technique directs clients to look at real photos so that the people, places, and experiences captured in them will jog memories of previously unremembered traumas (Dolan, 1991; Weiser, 2002).

Concerns about these techniques led Lindsay, Hagen, Read, Wade, and Garry (2004) to examine the effect of a real photograph to cultivate a false memory. Using a variation of the "lost in the mall" method, they asked subjects to remember three school experiences. Two of the experiences were real, and one was false; the false event described the subject putting Slime (the goopy green children's toy) into the teacher's desk drawer. All the subjects read a description of each event, and half also saw their real class photo to "help" them remember. While slightly fewer than half of the description-only subjects developed mental images of the Slime story or full memories, over 70% of the photo subjects did. These results show that even true photos can lead people to remember false events.

PHOTOGRAPHS AND MEMORY FOR THE MEDIA

In 2004, Britain's *Daily Mirror* newspaper published photos showing soldiers torturing Iraqi prisoners—photos the paper claimed to have received from other soldiers. Although accusations of such abuse were widespread, the photos were taken as proof that they were true. But the British Armed Forces noted a number of dubious details in the photos: They showed a vehicle never sent to Iraq, the prisoners looked too neat to have been beaten, and a trail of urine aimed at a prisoner by a soldier seemed to have had detail and shadows added to it. In short, the overall quality suggested trickery. A few weeks later, the *Daily Mirror's* headline proclaimed, "Sorry . . . we were hoaxed" (2004, May 15, p. 1) and the editor lost his job.

Research shows that photographs are eminently believable, even though people know they can be faked. For example, Kelly and Nace (1994) showed subjects bogus news stories from the *New York Times* and the supermarket tabloid *National Enquirer*. Although the *Times* was rated as a much more believable publication than the *National Enquirer*, the photographs in the *Enquirer* were rated as much more believable than the tabloid

itself. More importantly, subjects who saw a lengthy video about Photoshop's image-manipulation capabilities still maintained their belief in the relative veracity of both publications' photographs.

People are also more likely to remember the content of a news story when it is accompanied by a photograph. David (1998) showed subjects news stories that were or were not accompanied by a photograph and found that subjects were more likely to remember the stories when the stories had photographs.

Considered as a whole, the research suggests that photos enhance both the credibility of the news and people's memory for it. These findings led Garry, Strange, Bernstein, and Kinzett (2005) to examine the effect of different photographs on memory for a newspaper story. They asked subjects to pretend to be a newspaper editor and to study three news articles. One of the stories—the target—described a hurricane that tore through a Mexican coastal town, causing major property damage. While acting as editors, subjects proofread the stories, identifying and correcting minor typographical errors. They also received a photo that would accompany the each article, and they had to mark on the article where in the layout of the newspaper they thought the photo would look best. For half the subjects, the photo accompanying the hurricane article showed part of the town before the hurricane struck; for the other half, the photo showed the exact same spot after the hurricane struck.

The next day, subjects returned to the lab for a surprise memory test. On the test, they read a number of statements and indicated whether they had read each statement in one of the articles the day before. There were two types of statements on the test: old statements, which really had been in the articles, and new statements, which had not been in the articles but were related. For the hurricane story, some of the new statements described severe injuries to people in the story—even though the hurricane story recounted only property damage and no personal injuries.

Garry et al. (2005) found that although subjects had equally good memories for statements in the other stories, those who saw the "after" photo for the hurricane story were far more likely to claim they had read the descriptions of serious personal injury. In fact, fewer than 10% of subjects who saw the "before" photo falsely remembered reading about personal injury, while approximately a third of subjects who saw the after photo did. The choice of photos did not affect memory for other kind of statements. This study suggests that photographs can influence the way people remember the news.

CONCLUSIONS

If memory is the way people keep telling themselves their stories, then photographs are one of the ways people keep those stories alive. We have shown that both doctored and true photographs can cultivate false memories for personal experiences, and true photographs can lead to false memories for the news.

The research on photographs and memory has raised significant questions that warrant attention from many areas of inquiry. For example, in the area of psychological science, we do not know if, or how, photographs affect source monitoring in different situations. Do photographs, for instance, enhance imagination in some circumstances while constraining it in others? Does it matter if a photograph depicts the event itself (such as in the balloon studies) or merely depicts the protagonists (such as in the Slime study)? How do these two issues affect fluency, the ease with which the fictitious event is processed and springs to mind?

People often mistake a rush of surprising fluency as an indicator of truth (Bernstein, Whittlesea, & Loftus, 2002). In cognitive philosophy, the close relationship between photographs and memory relates to a question Clark and Chalmers (1998) raised about where one's mind stops and the rest of the world starts. That is, when can one say that an external device is actually part of—an extension of—one's own memory? People rely on some technologies so much, they argued, that to dismiss them as extensions of memory simply because they are external to the physical body seems like nitpicking.

In the area of personal identity, the act of remembering experiences that do not fit with people's personal identity causes more change in how they see themselves than does remembering experiences that do fit with their identity (Neimeyer & Metzler, 1994). Perhaps that change would be accelerated or magnified if the incongruent remembering were accompanied by a doctored photograph as evidence. Real photos certainly can have this impact, particularly when they contain a mix of known and unknown information. For example, Wigoder (2001) describes the case of a man who, nearly 50 years after WWII ended, came across a photo of himself as an emaciated young boy in a concentration camp. Confronted with the photo—evidence he recognized as being of a genuine experience but had never seen before—the man began to change the way he remembered life at the camp.

In the area of psychotherapy, can doctored photographs help clients reframe unpleasant personal history and, if so, is such a technique ethical? We know of at least one worrying example. Weiser's PhotoTherapy approach (Weiser, 2002) treats photographs as projective tests, with the therapist's job being to identify the client's common themes. Weiser eagerly anticipates the "exciting possibilities . . . for using photos as counselling tools with clients who have scanners . . . [and] photo-manipulation software" (p.24). On the other hand, doctoring images may lead to useful memory distortions. Kehle, Bray, Margiano, Theodore, and Zhou (2002) review research showing that when clients who engage in maladaptive behaviors—such as selective mutism (when a child speaks only in some contexts but not others), stuttering, or disruptive classroom behavior—view videos of themselves in which the unwelcome behaviors have been edited out, the maladaptive behaviors reduce. Kehle et al. propose a false-memory account of the effect: For example, stutterers who see manipulated videos of themselves speaking fluently may falsely remember speaking fluently more often than

they really do, causing them to become more confident that they can speak well—and thereby reducing their stuttering.

Finally—and regardless of the psychological mechanisms at play—research on the ways doctored photos can tamper with memory raises important questions about what people might confess if they are confronted with false evidence that they did or saw something that never happened.

Recommended Reading

- Lindsay, D.S., Hagen, L., Read, J.D., Wade, K.A., & Garry, M. (2004). (See References)
 Loftus, E.F. (2003). Our changeable memories: Legal and practical implications. *Nature Reviews Neuroscience*, 4, 231–234.
 Wade, K.A., Garry, M., Read, J.D., & Lindsay, D.S. (2002). (See References)
-

Acknowledgments—We are grateful to Kim Wade for many enlightening conversations on these topics. Maryanne Garry is supported by generous Marsden grants from the Royal Society of New Zealand, contracts VUW205 and VUW0405. Matthew Gerrie is supported by Marsden contract VUW205.

REFERENCES

- Bernstein, D.M., Whittlesea, B.W.A., & Loftus, E.F. (2002). Increasing confidence in remote autobiographical memory and general knowledge: Extensions of the revelation effect. *Memory & Cognition*, 30, 432–438.
 Clark, A., & Chalmers, D. (1998). The extended mind. *Analysis*, 58, 7–19.
 David, P. (1998). News concreteness and visual-verbal association: Do news pictures narrow the recall gap between concrete and abstract news? *Human Communication Research*, 25, 180–201.
 Dolan, Y.M. (1991). Resolving sexual abuse: Solution-focused therapy and Ericksonian hypnosis for adult survivors. New York: Norton.
 Garry, M., Strange, D., Bernstein, D., & Kinzett, T. (2005). *Photographs can distort memory for the news*. Manuscript submitted for publication.
 Garry, M., & Wade, K.A. (2005). Actually, a picture is worth less than 45 words: Narratives produce more false memories than photographs. *Psychonomic Bulletin & Review*, 12, 359–366.
 Johnson, M.K., Hashtroudi, S., & Lindsay, D.S. (1993). Source monitoring. *Psychological Bulletin*, 114, 3–28.
 Kehle, T.J., Bray, M.A., Margiano, S.G., Theodore, L.A., & Zhou, Z. (2002). Self-modeling as an effective intervention for students with serious emotional disturbance: Are we modifying children's memories? *Psychology in the schools*, 39, 203–207.
 Kelly, J.D., & Nace, D. (1994). Knowing about digital imaging and believing news photographs. *Visual Communication Quarterly*, 18(1), 4–5.
 Lindsay, D.S., Hagen, L., Read, J.D., Wade, K.A., & Garry, M. (2004). True photographs and false memories. *Psychological Science*, 15, 149–154.

- Loftus, E.F., & Pickrell, J.E. (1995). The formation of false memories. *Psychiatric Annals*, 25, 720–725.
- Neimeyer, G.J., & Metzler, A.E. (1994). Personal identity and autobiographical recall. In U. Neisser & R. Fivush (Eds.), *The remembering self: Construction and accuracy in the self-narrative* (pp. 105–135). NY: Cambridge University Press.
- Rosenberg, S. (1995, December). You can't believe your eyes. *Wired*, 3(12), 170–171.
- Sorry . . . we were hoaxed. (2004, May 15). *Daily Mirror*, p. 1.
- Wade, K.A., Garry, M., Read, J.D., & Lindsay, D.S. (2002). A picture is worth a thousand lies: Using false photographs to create false childhood memories. *Psychonomic Bulletin & Review*, 9, 597–603.
- Weiser, J. (2002). PhotoTherapy techniques: Exploring the secrets of personal snapshots and family albums. *Child & Family*, 5, 16–25.
- Wigoder, M. (2001). History begins at home. *History and memory: Studies in representations of the past*, 13, 19–59.

ences, and how to enhance cognitive skills?

- We need to identify the brain processes that influence cognition. Jensen has found correlations between *g* and elementary cognitive tasks (mental processing speed), the brain's electrical response to stimuli, and how quickly an injection of glucose is absorbed by the brain. Hope for further advance in this area lies in new techniques of viewing what brain centers are active when different cognitive tasks are being done.
- We should learn more about social multipliers. Boozer and Cacciola (2001) showed that when reduced class size raises academic performance, peer interaction multiplies that rise and accounts for virtually all of the long-term gains.
- The relative potency of Whites' and Blacks' social multipliers should be compared.
- Although teaching children "how to think" is desirable, we should recognize that this will not necessarily enhance numeracy and literacy. The focus must be on

teaching reading and arithmetic skills. And note that if we really want to enhance those skills, there will have to be an attitude shift, so that Americans welcome core subjects that make greater cognitive demands. If all parents and children were like Chinese Americans, the "nation's report card" would improve dramatically.

- Above all, we must go beyond *g* to develop a theory of intelligence with a sociological dimension. In this theory, *g* will still play an important role. Within every generation, people compete to win, and, therefore, *g* will always help explain why some people excel across so many cognitive skills.

Recommended Reading

- Deary, I.J. (2001). *Intelligence: A very short introduction*. Oxford, England: Oxford University Press.
- Dickens, W.T., & Flynn, J.R. (2001, April 21). Great leap forward. *New Scientist*, 170, 44–47.
- Jensen, A.R. (1998). *The g factor: The science of mental ability*. Westport, CT: Praeger.

Note

1. Address correspondence to J.R. Flynn, POLS, University of Otago, Box 56, Dunedin, New Zealand; e-mail: jim.flynn@stonebow.otago.ac.nz.

References

- Boozer, M., & Cacciola, S.E. (2001). *Inside the black box of Project STAR: Estimation of peer effects using experimental data* (Center Discussion Paper No. 832). New Haven, CT: Yale University Economic Growth Center.
- Greenfield, P. (1998). The cultural evolution of IQ. In U. Neisser (Ed.), *The rising curve: Long-term gains in IQ and related measures* (pp. 81–123). Washington, DC: American Psychological Association.
- Howard, R.W. (1999). Preliminary real-world evidence that average intelligence really is rising. *Intelligence*, 27, 235–250.
- Jensen, A.R. (1973). *Educability and group differences*. New York: Harper and Row.
- Jensen, A.R. (2002). Galton's legacy to research on intelligence. *Journal of Biosocial Science*, 34, 145–172.
- McWorter, J. (2000). *Losing the race: Self-sabotage in Black America*. New York: Free Press.
- Nunn, J. (1999). *John Nunn's chess puzzle book*. London: Gambit Publications.
- Rosenau, J.N., & Fagan, W.M. (1997). A new dynamism in world politics: Increasingly skilled individuals? *International Studies Quarterly*, 41, 655–686.
- Schooler, C. (1998). Environmental complexity and the Flynn effect. In U. Neisser (Ed.), *The rising curve: Long-term gains in IQ and related measures* (pp. 67–79). Washington, DC: American Psychological Association.

Spanking Children: Evidence and Issues

Alan E. Kazdin¹ and Corina Benjet

Child Study Center, Yale University School of Medicine, New Haven, Connecticut (A.E.K.), and National Institute of Psychiatry, Mexico City, Mexico (C.B.)

Abstract

Whether or not to spank children as a discipline practice is controversial among lay and professional audiences alike. This article highlights different views of spanking, key conclusions about its effects, and methodological limitations of the research and the resulting

ambiguities that fuel the current debate and plague interpretation. We propose an expanded research agenda to address questions about the goals of parental discipline; the role, if any, that punishment plays in achieving these goals; the effects and side effects of alternative discipline practices; and the impact of

punishment on underlying developmental processes.

Keywords

spanking children; punishment; parent discipline

Spanking as a way of disciplining children is a topic of broad interest to people involved in the care and education of children (e.g., parents, teachers), as well as to the many professions involved with children, parents, and families (e.g., pediatrics, psychiatry, psychology, and social work). Hitting children is intertwined with religious beliefs, cultural views, government, law, and social policy and

has enormous implications for mental and physical health throughout the world (Krug, Dahlberg, Mercy, Zwi, & Lozano, 2002). Corporal punishment as a means of child discipline at home and at school has been banned by many countries, including Austria, Croatia, Cyprus, Denmark, Finland, Germany, Israel, Italy, Latvia, Norway, and Sweden (Gershoff, 2002). The United Nations (Article 19 of the UN Convention on the Rights of Children) argues against all forms of physical violence in relation to children.

Within the United States, several organizations (e.g., Project No Spank—<http://www.nospank.net/toc.htm>) lobby for an end to hitting children and for according children the same legal protections accorded adults (i.e., laws against being hit by others). Despite the lobbying, spanking is still a “hit” with parents—it is quite prevalent. For example, in the United States, 74% of parents of children 17 years of age or younger use spanking as a discipline technique (Gallup, 1995); 94% of parents of 3- and 4-year-olds use corporal punishment (Straus & Stewart, 1999).

After decades of research, debate continues. In this article, we review key findings about the effects of spanking, issues that limit progress in understanding the effects of spanking, and avenues to move research forward. By discussing the topic, we are not in any way endorsing or advocating the use of spanking. Indeed, integral to the research agenda we propose are questions regarding why so many parents believe hitting is an appropriate and effective form of parental discipline and whether hitting is actually needed to accomplish the goals underlying its use in child rearing.

SPANKING DEFINED

Perhaps the most critical issue that underlies this debate is the def-

inition of spanking. The definition determines who participates in a research study, what studies are included in literature reviews, and, hence, what conclusions are reached. A commonly adopted definition specifies spanking as hitting a child with an open hand on the buttocks or extremities with the intent to discipline without leaving a bruise or causing physical harm. This definition helps separate occasional spanking from more severe corporal punishment (Baumrind, Larzelere, & Cowan, 2002; Consensus Statements, 1996).

Physical abuse usually is defined to encompass corporal punishment that is harsh and excessive, involves the use of objects (e.g., belts, paddles), is directed to parts of the body other than the extremities, and causes or has the potential to cause physical harm. Because many parents report using objects during punishment, behaviors that many professionals might consider as clearly abusive are fairly common and included in some definitions of spanking (Gershoff, 2002). Research on hitting (spanking, corporal punishment) varies widely on whether the definition includes practices that frankly are or blend into abuse.

THREE VIEWS OF SPANKING

Three positions about spanking as a form of discipline capture public and professional views rather well. The *pro-corporal punishment* view is infrequently advocated in research and academic writings, but is alive and well in everyday life. This view is represented by the familiar, cryptic, incomplete, and probably misconstrued biblical quotation, “spare the rod and spoil the child” (Proverbs 13:24). The view underscores the beliefs that desirable consequences (e.g., respect for authority, good behavior,

socialization) follow from the use of spanking, untoward consequences result from not spanking, and responsible parenting includes such punishment.

The *anti-corporal punishment* view is that corporal punishment is likely to have short- and long-term deleterious consequences. “Violence begets violence” captures much of this view, which focuses on modeling and social learning as the means by which violence is transmitted from one generation to the next (Straus, 1994). The morality of inflicting pain is also key to this view, so the untoward consequences of hitting are not the only basis for the objection to spanking.

The *conditional corporal punishment* view notes that the effects of spanking are not necessarily negative or positive but may be either depending on other conditions. Spanking can vary along multiple dimensions (e.g., frequency and intensity) and be delivered in many different contexts that may moderate its impact. This view does not advocate spanking, but rather notes that a “blanket injunction” against spanking cannot be supported scientifically (Baumrind, 1996).

OVERVIEW OF RESEARCH FINDINGS

The empirical literature on spanking has been reviewed extensively. The most recent and comprehensive review, completed by Gershoff (2002), consists of a meta-analysis² of 88 studies. Gershoff examined the relationship between corporal punishment and compliance of the child, moral internalization, aggression, criminal and anti-social behavior, quality of the parent-child relationship, mental health, and abuse. Spanking tended to be associated with imme-

mediate compliance of the child (i.e., desisting the behavior targeted by the punishment), which Gershoff considered to be the only positive outcome evident in her review. On the negative side, spanking was associated with decreased internalization of morals, diminished quality of parent-child relations, poorer child and adult mental health, increased delinquency and antisocial behavior for children, and increased criminal and antisocial behavior for adults; spanking also was associated with an increased risk of being a victim of abuse or of abusing one's own child or spouse.

Reanalyses of studies have underscored the importance of how spanking is defined. Several studies in Gershoff's review included rather harsh punishment that would qualify as physical abuse (e.g., slapping in the face, hitting with an object). Reanalyses indicated the outcomes were more negative in those studies than in studies of less severe punishment (Baumrind et al., 2002). Similarly, other reviews have suggested that very mild spanking used as a backup for mild disciplinary effects may not be detrimental and indeed can reduce noncompliance and fighting (Larzelere, 2000).

It would be difficult to identify a consensus among researchers beyond a few key points. First, the deleterious effects of corporal punishment are likely to be a function of severity and frequency. Harsh punishment is associated with many untoward consequences, including increased morbidity and mortality for major adult forms of illness (e.g., heart disease, cancer, lung disease; Krug et al., 2002). Second, the effects of mild spanking (an oxymoron to some people) that is occasional, is a backup to other disciplinary procedures such as time out from reinforcement or reasoning, is physically noninjurious, involves an open hand to hit the extremities or buttocks, and inflicts temporary pain are not so

clear (Baumrind et al., 2002). Again, there is no advocacy of corporal punishment in this latter view, but merely an acknowledgment that the research does not speak to the consequence of occasional spanking.

KEY ISSUES FOR RESEARCH

Fundamental conceptual and methodological issues plague the literature on spanking. First, the varied definitions of spanking can dictate the conclusions investigators and reviewers reach, as we have noted. Second, assessments of spanking and children's characteristics (e.g., aggression, deviance) often are retrospective and completed by the same rater (the parent). These influences alone can affect the magnitude of correlations of punishment, child characteristics, and outcomes. Third, the time line is rarely established to show that in fact spanking antedated an untoward outcome and that the "outcome" (e.g., child deviance, poor parent-child relations) was not present in advance of or at the same time as spanking. Fourth, spanking could well be a proxy for a host of other variables that in fact relate to untoward child outcomes. For example, compared with parents who spank less, those who spank more read to, play with, and hug their children less; experience higher levels of stress, more major life events, and more difficult, discordant, and abusive marital relations; and have higher rates of mental illness or substance abuse. These other variables, alone or in combination, might explain the effects attributed to spanking. However, redressing these pivotal methodological issues alone would still leave unanswered many critical questions that could inform the use of spanking (see Benjet & Kazdin, 2003).

Goals of Parent Discipline

Presumably, the goals of disciplining children are to decrease some behaviors (e.g., tantrums, talking back), to develop others (e.g., problem solving, playing cooperatively, completing homework), and to promote socialization more generally. It is not at all clear from animal laboratory studies and human applied studies that punishment is among the better strategies for accomplishing these behavior-change goals. For example, decreasing and eliminating inappropriate child behavior in the home can be achieved through positive reinforcement techniques (e.g., from many arrangements that focus on rewarding alternative behaviors) without the use of any punishment (Kazdin, 2001). In addition, noncorporal punishment techniques that are less aversive than spanking (e.g., brief periods of time out from reinforcement, small fines on a point chart) can be effective. The use of spanking raises questions regarding the goals of discipline, whether any punishment is needed to attain them, and, if in fact punishment is needed, whether hitting has any benefit over noncorporal punishment. Comparisons of punishment with nonaversive procedures, even in laboratory analogues, would add pertinent information that could inform debates about spanking. Additionally, the underlying processes motivating parents to spank or to continue to use spanking could be investigated to determine whether they are concordant with the stated goals of spanking.

Concomitant Effects of Punishment

Concomitant effects include any effects outside the direct focus of spanking and encompass the development of prosocial behaviors,

misbehavior other than the one to which spanking was directed, and emotional reactions (e.g., crying, anger). Gershoff (2002) found that children who were spanked were more angry, aggressive, and stressed than children who were not disciplined in this way. This finding is in keeping with other applied as well as animal laboratory research showing that punishment can have untoward side effects, including emotional reactions, aggression, and escape from and avoidance of people, settings, and situations associated with punishment (Hutchinson, 1977; Kazdin, 2001). These effects are particularly likely with corporal punishment, but they can occur with low levels of noncorporal punishment as well. Few studies have examined side effects of spanking and how these compare with the side effects that may result from equally effective (or more effective) strategies that do not rely on punishment.

Impact of Corporal Punishment on Development

Child abuse, a more extreme form of corporal punishment than is the focus of this article, can exert biochemical, functional, and structural changes in the brain (e.g., changes in cerebral volume and increased or decreased reactivity to various neurotransmitters; Glaser, 2000). Some of these changes have psychological concomitants (e.g., changes in reactivity to stress and in working memory). We do not wish to imply that spanking necessarily has any similar consequences or effects, but at the same time, it is not clear whether, how, or at what threshold the brain makes the distinction between child abuse and spanking. As a result, the circumstances under which spanking might also have such deleterious effects is uncertain.

Other psychological areas critical to development (e.g., attachment,

emotional regulation, stress of the child, parent-child relations) reflect critical brain-behavior-environment interactions that warrant attention. Although we do not challenge reviews claiming that very mild corporal punishment has not been shown to have either beneficial or deleterious effects, we argue that there is a need to look at how spanking might influence psychological processes critical to development. Research has already demonstrated that many developmental processes can be adversely influenced by harsh punishment.

Main Effects and Moderators

It is likely that any effects of parenting discipline practice are moderated by scores of variables related to the child, parent, family, and broader context (e.g., culture). The range of candidate variables to investigate is daunting, but there are exciting possibilities. Advances in molecular genetics will no doubt lead to breakthroughs that move researchers closer to understanding mechanisms and to identifying subgroups of youths who might be especially vulnerable to various discipline practices. For example, boys who are maltreated are likely to develop antisocial behavior if they have a particular gene characteristic related to one of the brain's neurotransmitter systems (Caspi et al., 2002). There are not many models that have been proposed and tested to explain influences that moderate the effects of spanking. This is a difficult topic in part because a study might implicitly endorse spanking as a good, or at least neutral, practice for some children and families and as a detrimental practice for others, or even unwittingly "blame" the child for extreme reactions to corporal punishment. The study of moderators of the effects of spanking is a charged topic because it could be

unwittingly construed as advocating hitting some children but not others. We have already raised the question of whether spanking is needed at all in child rearing.

CLOSING COMMENTS

Objections to spanking are made on moral, humane, and legal grounds (e.g., the immorality of inflicting pain, unequal treatment of children and adults under the law). These objections are critical insofar as they apply to all hitting of children and are independent of the evidence on the effects of spanking. The evidence suggests that spanking that is frequent and harsh is often associated with undesirable mental and physical health outcomes.

The effects of very mild, occasional spanking are not well studied or sufficiently clear from available studies. In one sense, it may be correct to say that current evidence does not establish the deleterious or beneficial effects of very mild spanking. Even so, it may be prudent to caution against the use of spanking because there are nonaversive alternatives for accomplishing the same disciplinary goals, and because it has not been empirically established where the demarcation is between mild spanking that may be safe to use and severe corporal punishment that is known to be dangerous. Moreover, mild spanking can escalate and apparently does mix in with more severe hitting (Gershoff, 2002). Thus, the many health, psychological, and neurological consequences of harsh punishment cannot be dismissed as irrelevant to mild spanking. One of the reasons that there is a debate about the effects of spanking is that investigators who study spanking and the parents and teachers who interact with children cannot ad-

here consistently to a delimited and crisp definition of spanking or hitting that is "mild and occasional."

From a parenting and policy perspective, the basic question is, why use corporal punishment at all? Mild noncorporal punishments such as brief time out from reinforcement or short-term loss of privileges in the context of praise and rewards can accomplish the goals for which spanking is usually employed. After years of research, critical questions about mild forms of corporal punishment remain. We have suggested some lines of work to inform discussions about the practice of spanking and its effects. More longitudinal studies are needed to help establish time lines between spanking and desirable and undesirable outcomes, competing constructs that may explain the effects attributed to spanking need to be ruled out more persuasively, and animal laboratory studies could be brought to bear more forcefully on the topic. Human and animal laboratory studies evaluating transient and enduring biological and behavioral reactions to punishment will be critical for illuminating the developmental processes that are influenced by corporal punishment and whether distinctions in the severity and frequency

of punishment are relevant to these processes.

Recommended Reading

- Benjet, C., & Kazdin, A.E. (2003). (See References)
- Gershoff, E.T. (2002). (See References) (Multiple commentaries follow this article)
- Larzelere, R.E. (2000). (See References)
- Straus, M.A., & Stewart, J.H. (1999). (See References)

Acknowledgments—The authors are very grateful for very thoughtful comments provided by Celia B. Fisher and Kimberly Hoagwood. Completion of this article was facilitated by support from the Leon Lowenstein Foundation, the William T. Grant Foundation (98-1872-98), and the National Institute of Mental Health (MH59029).

Notes

1. Address correspondence to Alan E. Kazdin, Child Study Center, Yale University School of Medicine, 230 S. Frontage Rd., New Haven, CT 06520-7900.

2. Meta-analysis combines the effects of several studies using a common unit of analysis. For each study, groups are compared (e.g., children who have been spanked vs. those who have not), and their difference is placed into a common metric that permits studies to be compared and combined.

References

- Baumrind, D. (1996). A blanket injunction against disciplinary use of spanking is not warranted by the data. *Pediatrics*, *98*, 828-831.
- Baumrind, D., Larzelere, R.E., & Cowan, P.A. (2002). Ordinary physical punishment: Is it harmful? Comment on Gershoff (2002). *Psychological Bulletin*, *128*, 580-589.
- Benjet, C., & Kazdin, A.E. (2003). Spanking children: The controversies, findings, and new directions. *Clinical Psychology Review*, *23*, 197-224.
- Caspi, A., McClay, J., Moffitt, T.E., Mill, J., Martin, J., Craig, I.W., Taylor, A., & Poulton, R. (2002). Role of genotype in the cycle of violence in maltreated children. *Science*, *297*, 851-854.
- Consensus Statements. (1996). *Pediatrics*, *98*, 853.
- Gallup Organization. (1995). *Disciplining children in America: A Gallup poll report*. Princeton, NJ: Author.
- Gershoff, E.T. (2002). Parental corporal punishment and associated child behaviors and experiences: A meta-analytic and theoretical review. *Psychological Bulletin*, *128*, 539-579.
- Glaser, D. (2000). Child abuse and neglect and the brain: A review. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *41*, 97-116.
- Hutchinson, R.R. (1977). By-products of aversive control. In W.K. Honig & J.E.R. Staddon (Eds.), *Handbook of operant behavior* (pp. 415-431). Englewood Cliffs, NJ: Prentice-Hall.
- Kazdin, A.E. (2001). *Behavior modification in applied settings* (6th ed.). Belmont, CA: Wadsworth.
- Krug, E.G., Dahlberg, L.L., Mercy, J.A., Zwi, A.B., & Lozano, R. (2002). *World report on violence and health*. Geneva, Switzerland: World Health Organization.
- Larzelere, R.E. (2000). Child outcomes of nonabusive and customary physical punishment by parents: An updated literature review. *Clinical Child and Family Psychology Review*, *3*, 199-221.
- Straus, M.A. (1994). Should the use of corporal punishment by parents be considered child abuse? Yes. In M.A. Mason & E. Gambrill (Eds.), *Debating children's lives* (pp. 195-203, 219-222). Thousand Oaks, CA: Sage.
- Straus, M.A., & Stewart, J.H. (1999). Corporal punishment by American parents: National data on prevalence, chronicity, severity, and duration, in relation to child and family characteristics. *Clinical Child and Family Psychology Review*, *2*, 55-70.

TABLE 1

Definitions of Temperament in the Children's Behavior Questionnaire and the Early Adolescent Temperament Questionnaire

Broad dimensions/ Temperament scales	Scale definitions
Effortful control	
Attention Control	The capacity to focus attention as well as to shift attention when desired
Inhibitory Control	The capacity to plan future action and to suppress inappropriate responses
Perceptual Sensitivity	Detection or perceptual awareness of slight, low-intensity stimulation in the environment
Low-Intensity Pleasure	Pleasure derived from activities or stimuli involving low intensity, rate, complexity, novelty, and incongruity
Negative affectivity	
Frustration	Negative affect related to interruption of ongoing tasks or goal blocking
Fear	Negative affect related to anticipation of distress
Discomfort	Negative affect related to sensory qualities of stimulation, including intensity, rate, or complexity of light, movement, sound, or texture
Sadness	Negative affect and lowered mood and energy related to exposure to suffering, disappointment, and object loss
Soothability	Rate of recovery from peak distress, excitement, or general arousal
Extraversion/surgency	
Activity	Level of gross motor activity including rate and extent of locomotion
Low—Shyness	Behavioral inhibition to novelty and challenge, especially social
High-Intensity Pleasure	Pleasure derived from activities involving high intensity or novelty
Smiling & Laughter	Positive affect in response to changes in stimulus intensity, rate, complexity, and incongruity
Impulsivity	Speed of response initiation
Positive Anticipation	Positive excitement and anticipation for expected pleasurable activities
Affiliation ^a	Desire for warmth and closeness with others, independent of shyness or extraversion

Note. Subscales are grouped according to their broad dimensions.

^aIn Early Adolescent Temperament Questionnaire only.

psychometric studies have refined these categories (Rothbart & Bates, 2006). Temperament dimensions that have now emerged show strong similarities to the structure of temperament in other animals, including the defensive reactions of fear and anger, approach reactions of activity and pleasure to high intensity stimulation, and attentional scales of duration of orienting in infancy and of EC in toddlerhood. Recent research with the Children's Behavior Questionnaire (Rothbart, Ahadi, Hershey, & Fisher, 2001), a parent report measure for children 3 to 7 years of age, also identified three broad dimensions of temperament described in Table 1 and depicted in Figure 1.

These dimensions of temperament are related to the Big Five personality factors of Extraversion (extraversion/surgency), Neuroticism (negative affectivity), and Conscientiousness (EC). The Openness and Agreeableness factors have been found to relate to the adult temperamental dimensions of perceptual sensitivity and affiliation (Evans & Rothbart, 2007). It is important to remember, however, that temperament theory goes beyond a list of unrelated traits or broad dimensions. Of central importance are the interactions between children's reactive impulses and their efforts to control them. In particular, researchers are interested in the relations among EC, extraversion/surgency, and negative affectivity.

Very similar broad dimensions of temperament have been found across cultures, and different correlations among these dimensions in the United States and China are shown in

Figure 1 (Ahadi, Rothbart, & Ye, 1993). In the United States, but not in China, children high in EC showed lower negative affectivity. In China, but not in the United States, children high in EC showed lower extraversion/surgency. These differences may be related to culturally valued behaviors (low distress in the United States; low outgoing behavior in China), guiding development. Basic biological processes of temperament appear to be shared across cultures, but outcomes vary depending on cultural values and the child's experiences.

DEVELOPMENT OF TEMPERAMENT

Temperament characteristics can be seen in the newborn and measured in the fetus. The newborn shows distress and avoidant movements, and by 2 to 3 months, approach reactions are evidenced in smiling, laughter, and body movement. Physical approach is seen when developing motor systems permit, usually by 4 to 6 months. Anger or frustration is seen at 2 to 3 months, and fear in the form of behavioral inhibition appears to be differentiated from general distress proneness by 7 to 10 months. Fear in infancy predicts children's later fearfulness and low aggression; anger predicts later higher frustration and aggression. Fear thus appears to act as a control on both approach and aggression (Rothbart & Bates, 2006).

Fear is a reactive dimension that also contains regulatory components (behavioral inhibition or withdrawal from threat-

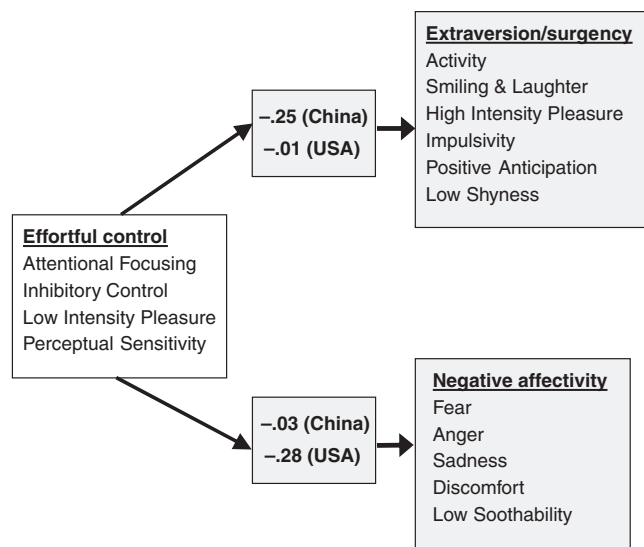


Fig. 1. Temperament in 6- to 7-year-old children from the United States and China as evaluated by the Children's Behavior Questionnaire. The similar overall temperament structure suggests that the basic building blocks of temperament are the same in both cultures; but their relationships differ, as shown by the correlations in the middle boxes.

ening stimulation). As noted above, behavioral fear develops later than approach responses. Although fear serves to inhibit approach and aggression, it may also capture attention (Rothbart & Sheese, 2007). A second, attentional control system, EC, allows more flexible inhibition of action (not eating a rich dessert), facilitation of action (eating more vegetables instead), detection of errors, and planning. EC as measured in laboratory tasks develops strongly over the preschool and into the school years. By 30 months, children show consistency in performance across tasks and considerable stability of EC is found thereafter (Kochanska, Murray, & Harlan, 2000; Rothbart, Sheese, & Posner, in press).

TEMPERAMENT AND SOCIALIZATION-RELEVANT CHARACTERISTICS

Temperament is consistently related to important social behaviors such as empathy and conscience. In my research, infant fear predicted parent-reported guilt, empathy, and low aggression at age 6 to 7 years. In Kochanska, Aksan, and Joy's (2007) research, more fearful children developed greater conscience during the preschool years than less fearful children did. Fear provides internal cues of discomfort that can be attributed to conscience rather than to external reward or coercion. The relation between temperament and conscience was also affected by parenting. Fearful children who received gentle and nonpunitive socialization developed greater conscience than did fearful children whose parents were punitive. For more fearless children, conscience depended on another aspect of parenting. More fearless children who had positive relations with their

parents developed greater conscience than fearless children whose relations with their parents were less positive.

EC also positively predicts conscience (Kochanska et al., 2000), as well as empathy, guilt, and low aggressiveness. EC may provide the attentional flexibility needed to react to negative feelings in others without being overwhelmed by them (empathy) and to relate these feelings to responsibility for one's own actions (conscience). Thus, two control systems, one emotional (fear) and one attentional (EC), appear to influence the development of conscience: Fear provides the distress and reactive inhibition components, and EC provides the attentional flexibility needed to link distress cues, action, and moral principles. A review by Eisenberg, Smith, Sadovsky, and Spinrad (2004) provides important additional findings relating EC to social and personality development.

Temperament is also an important contributor to a lower incidence of behavior problems, and this is found even when there is no overlap in content between the temperament and psychopathology measures (Rothbart & Bates, 2006). Figure 2 depicts relations reported in the literature, including a recent study by Ormel et al. (2005), which used the Early Adolescent Temperament Questionnaire–Revised to relate temperament at 10 to 11 years to the development of behavior problems at 12 to 14 years. Extraversion/surgency is related to greater externalizing problems (acting out) and to fewer internalizing problems (fear, sadness, low self-esteem). Anger and frustration predict both internalizing and externalizing problems, but fear is more strongly related to internalizing and anger to externalizing difficulties. The new scale of Affiliativeness in the Early Adolescent Temperament Questionnaire predicted both high internalizing and low externalizing problems. Low EC is a consistent and strong predictor of externalizing problems and a less strong predictor of internalizing problems. EC also moderates the effects of negative affectivity on problems; highly negative children will be less likely to show problems when they have higher EC (Rothbart & Bates, 2006; Rothbart & Posner, 2006).

NEURAL CORRELATES OF TEMPERAMENT

One exciting aspect of temperament is that it can be studied at multiple levels. Reactive temperament, for example, has been related to neural structure, especially to the functioning of the amygdala and (for extraversion/surgency) to dopamine systems (Rothbart & Posner, 2006). In the laboratory, researchers have studied the brain's attentional networks, which develop over time and are related to individual differences in EC. Monitoring and resolving conflict between incompatible responses have been linked to specific executive attention networks in the brain (Posner & Rothbart, 2007b). A basic measure of conflict resolution is provided by the Stroop task, in which the name of a word conflicts with the name of the color it is printed in. Tasks such as the Attention Networks Test (ANT) present flanking stimuli that distract from the task of responding to a central stimulus. Stroop

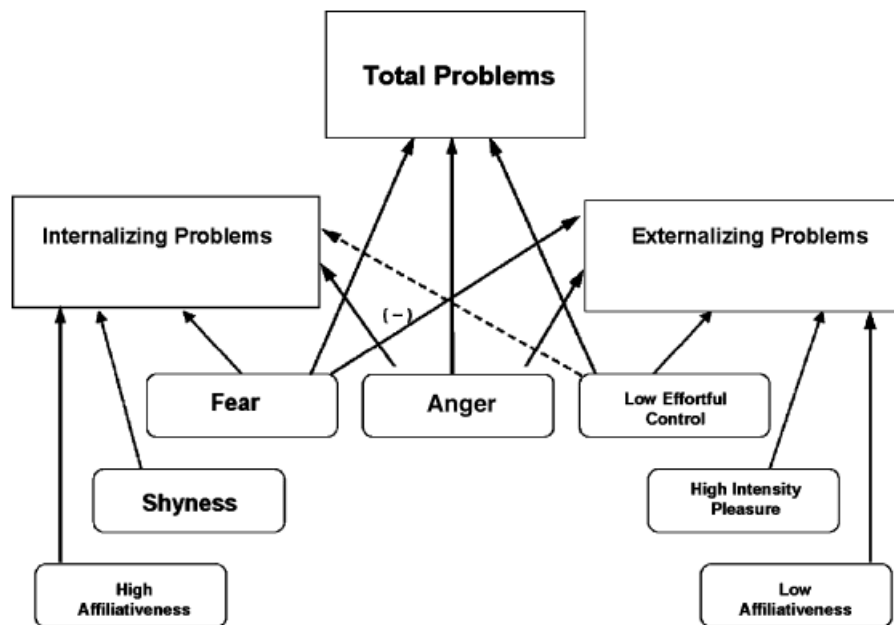


Fig. 2. Temperament in relation to developing behavior problems. Internalizing problems refers to anxious, inhibited, depressed, and withdrawn behavior; externalizing problems refers to disruptive, aggressive, and hyperactive behavior. The broken line denotes a weak relation.

and flanker tasks used in adult imaging studies activate the anterior cingulate and lateral prefrontal areas of the brain, which are parts of the executive attention network (Posner & Rothbart, 2007a; Rothbart et al., in press).

When Stroop and flanker tasks are adapted for children as markers of executive attention development, researchers can trace brain function through children’s performance. For toddlers, the spatial conflict task is used. Here the child must match an animal picture (dog or cat) cue with a picture of the same animal on one of two response keys. The location of the key can be directly below the cue or on the opposite side. There is a strong tendency to respond on the same side as the cue and the child must overcome this conflict to make the correct response. (see Posner & Rothbart, 2007a). At 30 months (the age when Kochanska et al., 2000, found EC tasks to be related), children moved from repeatedly performing the same incorrect response to showing more accurate performance. By 3 years, they showed high accuracy but were slower in the conflicting condition, as is found in adults. Preschool children who performed well on the tasks also scored higher in measures of EC and lower on impulsivity and were less prone to frustration (as evaluated by the Children’s Behavior Questionnaire). By age 7, the rapid period of development of executive attention appears to be complete.

TRAINING AND GENETICS OF EXECUTIVE ATTENTION

Given the central importance of EC and executive attention to development, can these systems be influenced by experience? Previously, researchers in our laboratory created a set of training exercises to help preschool children develop executive attention

skills (Rueda, Rothbart, McCandliss, Saccamanno, & Posner, 2005). Exercises were adapted from tasks used to train monkeys for space travel. Children ranging in age from 4 to 6 years were trained to use a joystick as they controlled the movement of a cat on the screen. They were instructed to guide the cat to the grass without getting in the mud (see Fig. 3). Over trials, the grass area

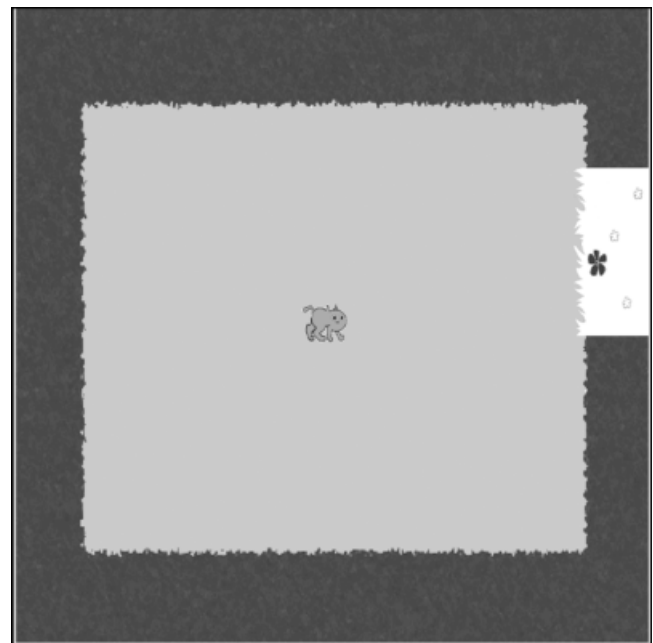


Fig. 3. Attention-training exercise (the cat seeking grass). As the extent of the mud (the dark gray area around the perimeter of the picture) increases, the extent of the grass (the white patch on the right) decreases. When the grass area becomes very small, the children are using the cat as a cursor to be moved from one spot to another.

shrinks and the mud area expands, so that the child is effectively moving the cat as a cursor. Children then learn how to have the cat move to intercept the travel of a duck, who either visibly swims across a pond or dives into it, and are trained on working-memory and Stroop-like conflict tasks.

These exercises were completed in five training sessions, with pre- and posttraining assessments including the ANT described previously and the Kaufman-Brief Intelligence Test. During ANT performance, 128 channels of electroencephalography were also recorded. We wished to measure the negative brain response arising around 200 milliseconds following the target (N2), which in adults arises in the anterior cingulate and is related to conflict performance.

Both 4- and 6-year-old children who had undergone training performed better on conflict trials than did children in the control group, but performance was highly variable and the difference did not reach statistical significance. Analysis of the N2 data, however, indicated that the trained children showed a more adultlike response. Intelligence scores of trained children were also higher after this brief training. Temperament measures were not affected, but both EC and children's distress proneness may be influenced if longer training programs were used, as in preschool settings (Posner & Rothbart, 2007a).

Executive attention efficiency has also been related to alleles (variants) of specific genes in both adults and children (Posner et al., 2007), and in children, genetic alleles have been related to parent reports of negative affectivity, EC, and extraversion/surgency. Researchers at the University of Oregon have also recently found an interaction between specific genes and parenting in the prediction of children's temperament. Research on genes and the development of temperament and personality will be of great interest in future studies.

FUTURE DIRECTIONS

This article provides a brief review of advances in our understanding of temperament and development. These advances have been considerable, but much remains to be learned. Future studies will explore temperament in relation to how children experience their social and physical world and their development of situation-specific behavior. Genetic analyses will allow for a much more differentiated study of temperament in relation to experience in children's development. By studying temperament at behavioral, mental, and brain-network levels and by investigating children's variability, development, and psychopathology, researchers will make increasing progress in this area (Posner & Rothbart, 2007b).

Recommended Reading

- Eisenberg, N., Smith, C.L., Sadovsky, A., & Spinrad, T.L. (2004). (See References)
 Kochanska, G., Murray, K.T., & Harlan, E.T. (2000). (See References)

- Posner, M.I., & Rothbart, M.K. (2007a). (See References)
 Rothbart, M.K., & Bates, J.E. (2006). (See References)
 Rothbart, M.K., & Posner, M.I. (2006). (See References)
-

Acknowledgments—The research reported here was supported by National Institutes of Mental Health Grants MH43361 and MH01471 and by a McDonnell Foundation grant. The author wishes to thank Michael Posner and Myron Rothbart for their help in developing this review.

REFERENCES

- Ahadi, S., Rothbart, M.K., & Ye, R. (1993). Children's temperament in the United States and China: Similarities and differences. *European Journal of Personality*, *7*, 359–378.
- Eisenberg, N., Smith, C.L., Sadovsky, A., & Spinrad, T.L. (2004). Effortful control: Relations with emotion regulation, adjustment, and socialization in childhood. In R.F. Baumeister & K.D. Vohs (Eds.), *Handbook of self-regulation: Research, theory, and applications* (pp. 259–282). New York: Guilford.
- Evans, D., & Rothbart, M.K. (2007). Developing a model for adult temperament. *Journal of Research in Personality*, *41*, 868–888.
- Kochanska, G., Aksan, N., & Joy, M.E. (2007). Children's fearfulness as a moderator of parenting in early socialization: Two longitudinal studies. *Developmental Psychology*, *43*, 222–237.
- Kochanska, G., Murray, K.T., & Harlan, E.T. (2000). Effortful control in early childhood: Continuity and change, antecedents, and implications for social development. *Developmental Psychology*, *36*, 220–232.
- Ormel, A.J., Oldehinkel, A.J., Ferdinand, R.F., Hartman, C.A., de Winter, A.F., & Veenstra, R. (2005). Internalizing and externalizing problems in adolescence: General and dimension-specific effects of familial loadings and preadolescent temperament traits. *Psychological Medicine*, *35*, 1825–1835.
- Posner, M.I., & Rothbart, M.K. (2007a). *Educating the human brain*. Washington, DC: American Psychological Association.
- Posner, M.I., & Rothbart, M.K. (2007b). Research on attentional networks as a model for the integration of psychological science. *Annual Review of Psychology*, *58*, 1–23.
- Posner, M.I., Rothbart, M.K., & Sheese, B.E. (2007). Attention genes. *Developmental Science*, *10*, 24–29.
- Rothbart, M.K., Ahadi, S.A., Hershey, K., & Fisher, P. (2001). Investigations of temperament at three to seven years: The Children's Behavior Questionnaire. *Child Development*, *72*, 1394–1408.
- Rothbart, M.K., & Bates, J.E. (2006). Temperament. In W. Damon, R. Lerner, & N. Eisenberg (Eds.), *Handbook of child psychology: Vol. 3. Social, emotional, and personality development* (6th ed., pp. 99–166). New York: Wiley.
- Rothbart, M.K., & Derryberry, D. (1981). Development of individual differences in temperament. In M.E. Lamb & A. Brown (Eds.), *Advances in developmental psychology* (Vol. 1, pp. 37–86). Hillsdale, NJ: Erlbaum.
- Rothbart, M.K., & Posner, M.I. (2006). Temperament, attention, and developmental psychopathology. In D. Cicchetti & D. Cohen (Eds.), *Developmental psychopathology: Vol. 2. Developmental Neuroscience* (2nd ed., pp. 465–501). New York: Wiley.

- Rothbart, M.K., & Sheese, B.E. (2007). Temperament and emotion regulation. In J.J. Gross (Ed.), *Handbook of emotion regulation* (pp. 331–350). New York: Guilford.
- Rothbart, M.K., Sheese, B.E., & Posner, M.I. (in press). Executive attention and effortful control: Linking temperament, brain networks, and genes. *Perspectives in Developmental Psychology*.
- Rueda, M.R., Rothbart, M.K., McCandliss, B.D., Saccamanno, L., & Posner, M.I. (2005). Training, maturation, and genetic influences on the development of executive attention. *Proceedings of the National Academy of Sciences, USA, 102*, 14931–14936.
- Thomas, A., & Chess, S. (1977). *Temperament and development*. New York: Bruner/Mazel.