Human Development

Letters to the Editor

Moshman on Adolescent and Teen Brains: Some Valid Points, but Wrong in Several Respects

David Moshman's commentary [2011], in which he asserts that contemporary brain science has led us to mistakenly view adolescents as less mature or more irrational than adults, makes several valid points, but it is wrong in several respects.

First, there is unequivocal evidence that there are substantial structural and functional changes in the brain that occur between adolescence and adulthood (for several excellent summaries of this literature, see the February 2010 issue of *Brain & Cognition,* which is devoted entirely to adolescent brain development). Whether this change is quantitative or qualitative, or whether there is variability among adolescents or among adults, is not the issue. The issue is whether between-age variability is greater than within-age variability, and in this regard, the findings are clear: Structurally and functionally, the brain of the average 15-year-old is different than that of the average 25-year-old, and new studies in support of this contention are appearing every month in top-tier, peer-reviewed neuroscience journals.

Second, while Moshman is certainly correct that brain maturation is driven by both experience and biology, no sensible scientist, including those whose work supports the idea that the adolescent brain is different from the adult brain, has ever suggested otherwise. Along similar lines, linking observed age differences in behavior to observed age differences in brain structure or function does not suggest that the behavioral differences are determined by biology alone. Moshman and others have constructed a 'straw biodeterminist' that is easy to attack, but does not exist, except perhaps in the form of the New Yorker cartoonists trying to get a laugh, or a general public that relies on newspaper headlines or popular magazine covers for its education about human development.

Third, Moshman confuses the argument that adolescents, on average, are less mature than adults (which is true in some, but not all, respects of psychological functioning) with the argument that all adolescents are inherently less mature than all adults, or that no adults have ever behaved in an irrational or immature fashion. Moshman is correct that age differences are small or nonexistent when it comes to logical reasoning and most basic cognitive processes, but statistically reliable group differences between adolescents and adults in impulsivity, sensation-seeking, and reward sensitivity have been repeatedly demonstrated, both behaviorally and with respect to the underlying neurobiology, not only among humans [Steinberg, 2008], but in other mammalian species that also undergo a period of behavioral and neurobiological change around the time of puberty [Spear, 2009]. No one has ever suggested, as far as I know, that adults never take risks, exercise poor judgment, or behave impulsively, or that adolescents always do. Again, the issue is whether between-group variability is greater than within-group variability.

Moshman's assertion that adolescents 'are not so different from [adults] with respect to their brains, cognition, and behavior' is simply not supported by the facts. Whether these differences warrant society's distinguishing between adolescents and adults is a different matter, and we ought not confuse the two issues [Steinberg, 2009]. Moshman and others may have objections to how the science has been interpreted or applied, but this does not make the science wrong.

Laurence Steinberg
Temple University, Philadelphia, Pa., USA

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Not the Full Research Story on Teen Brains

David Moshman's [2011] Editor's Corner stated that developmental science has failed to document real differences in behavior, brain structure, or brain function between adolescents and adults. Although Moshman presents several thought-provoking points that illuminate challenges within our field, his claims fail to appreciate a large and growing body of literature on this topic.

According to Moshman, adolescent risk-taking is a 'phenomenon that does not exist' because adolescents and adults both take risks, and adolescents and adults can both behave rationally. Of course, he is correct that there is substantial variability in rational and risky behavior across people. However, a number of empirical studies document context-dependent increases in risky choices during adolescence that are statistically reliable in spite of individual differences. For example, adults and adolescents make equivalently rational choices on gambling tasks when those choices are premeditated [Figner, Mackinlay, Wilkening, & Weber, 2009]. Yet when the situation becomes emotionally charged by introducing an arousing 'hot' context, adolescents are significantly more likely than adults to keep playing past the rational stopping point. Moshman is correct that in some contexts (in this case, premeditated decision contexts), adolescents make choices that are as rational as adults. However, adolescents are also more susceptible to emotional influences on choice behavior, a conclusion that has been conceptually replicated in a variety of emotionally charged contexts [e.g., Chein, Albert, O'Brien, Uckert, & Steinberg, 2010; Cohen et al., 2010; Gardner & Steinberg, 2005; Padmanabhan, Geier, Ordaz, Teslovich, & Luna, 2011; Somerville, Hare, & Casey, 2011].

Moshman also asserted that neuroscience has failed to (a) document differences between adolescent and adult brains, and (b) interpret changes in brain activity in the context of behavior. Research using robust methods and large samples has documented continued structural and connectivity-based brain development throughout adolescence [e.g., Giedd, 2008; Fair et al., 2007]. In addition, a number of laboratories regularly combine psychological and neuroscientific inquiry to provide brain-behavior linkages within a single group of participants. In our own work [Somerville et al., 2011], we assessed the performance of children, adolescents, and adults on an emotional go/no go task where participants pressed a button, or withheld that button press, in response to happy and neutral faces. Behaviorally, adolescents made more commission errors to happy faces relative to neutral ones, yielding error rates that were statistically greater than for children as well as adults. This pattern suggests that adolescents, as a group, were significantly more susceptible to interference by emotionally arousing positive cues than either adults or children. Simultaneous behavioral and fMRI recording allowed us to interpret differences in brain activity within the context of these observed behavioral differences. Neural activity patterns demonstrated how engagement of affect valuation systems of the brain was amplified during

adolescence, which contrasted with differences in activity in cortical control regions that predicted task performance [for converging evidence, see Galvan et al., 2006; Van Leijenhorst et al., 2010]. This study represents just one of dozens of peer-reviewed, published reports informing how developmental changes in functional brain circuitry parallel measured features of adolescent behavior.

An implicit theme of Moshman's essay is that adolescents' rational capabilities are underestimated. Given society's intrinsic interest in this area of research, his letter serves as a cautionary note for scientists who consult with policymakers, the media, and the public. However, concluding that adolescents and adults are psychologically and neurobiologically indistinguishable flies in the face of a large body of published literature not addressed in Moshman's commentary. Considering their age and amount of experience with the world, adolescents are remarkably capable; they are also fundamentally unique. These two conclusions need not be in opposition.

Leah H. Somerville and B.J. Casey
Weill Cornell Medical College, New York, N.Y., USA

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Adolescents Are Not Simply Young Adults

In the article entitled ‘Adolescents and their teenage brains,’ Moshman [2011] basically argues that adolescent brain development cannot be all that important because adolescents do not differ that much from adults in their cognitive and behavioral functions. Some of the conclusions reached by Moshman seemingly reflect unusual conceptions of work in this area and appear relatively unfettered by considerations of the associated research literature.

Moshman uses adolescent risk-taking as an example to argue that adolescents reason similarly to, and are not less rationale than, adults. The crux of his argument is that risk-taking is not the sole purview of adolescents and that adults also take risks. While this is of course true, stating that adults also take risks provides an insufficient basis to argue that adolescents do not differ from adults in their risk-taking propensity (or in how, when, and why they take risks). This logic is analogous to saying that the conclusion that men are bigger on average than women would be negated by observations that some women are taller and heavier than some men. Examination of the empirical data on adolescent risk-taking reveals evidence that adolescents sometimes, although not always, show a greater propensity for risk-taking than do adults. The circumstances under which adolescents do and do not show elevated risk-taking compared to adults is telling, with the risk behavior of adolescents often similar to adults under test conditions favoring logical and reasoned decision-making, but elevated under conditions promoting emotional affect during risk

taking [e.g., Figner, Mackinlay, Wilkening & Weber, 2009; Reyna, Estrada, DeMarinis, Myers, Stanisz & Mills, 2011], including tests conducted in the presence of peers [e.g., Gardner & Steinberg, 2005]. Further exploration of the circumstances under which adolescents do and do not differ from adults in their risk-taking propensities will likely prove critical for developing strategies to support adolescent exploration of exciting and stimulating environments while constraining untoward consequences of their risky behaviors (including mortality, with a majority of the deaths among late adolescents in the USA resulting from risk-taking and other behavioral causes) [e.g., Irwin, Burg & Cart, 2002].

Turning to adolescent brain development, Moshman makes the point that adolescent behaviors and cognitions cannot be explained merely from consideration of the adolescent brain. I agree with this general assertion, while whole-heartedly seconding his additional statement that 'brain research is crucial for a full picture.' Indeed, in conjunction with cognitive and behavioral studies of adolescents, functional imaging studies are providing critical converging evidence regarding how adolescents differ from adults in the ways they process different types of information, and react to and learn about their environment. Developmental brain imaging studies have also provided exciting clues as to how adolescent neurocognitive development may contribute to adolescent-typical ways of thinking and behaving. The second part of Moshman's adolescent brain discussion – where he implies that adolescent brain development is commonly (and erroneously) viewed as being genetically driven – is more problematic and appears more of a 'straw man' than a point of contention per se. Indeed, with the increasing recognition that genes and the environment are inexorably interrelated, the old dichotomy of 'nature' [genes (G)] versus 'nurture' [environment (E)] has not been seriously argued in many years. Instead, current work focuses on epigenetic regulation and the rapid malleability and sensitivity of the genome to environmental alterations [e.g., Kendler, Jaffee & Romer, 2011]. Recognition of the critical importance of G × E interactions during development provides exciting fodder for exploring the possibility of developmental neuroplasticity during adolescence, and the unique opportunities and vulnerabilities that such environmentally driven plasticity could provide.

Development is a life-long process, and hence it could be argued that parsing the continuum into stages is arbitrary and essentially a matter of semantics. Yet, Moshman's suggestion of viewing adolescence as merely part of young adulthood devalues the importance of the considerable challenges and impressive accomplishments of this developmental transition. Embedded within a background of physiological changes such as puberty, a growth spurt, and transformations in the brain, the necessary goals of adolescence include learning from and adapting to the environment in ways sufficient: (a) to promote the adolescent's transition from parental dependence to the relative independence of adulthood, (b) to attain the necessary social network, knowledge, and skills to thrive in adulthood, and (c) to ultimately support successful

reproduction and maturation of the next generation. The challenges and opportunities afforded by these tasks may especially benefit from provision of safe, supportive and stimulating environments during adolescence – an investment that may not be considered if adolescents are viewed merely as the lower end of the adult continuum. Adolescents are not simply young adults, and the costs of treating them so could prove considerable.

Linda Patia Spear
Binghamton University, State University of New York, Binghamton, NY, USA

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Some Progress with Teenage Brains – but Let's Not Ignore the New Toddler Brain

David Moshman's [2011] Editor's Corner essay is a welcome addition to mounting critique of some of the wilder yet widely disseminated accounts of limited cognitive, emotional, and social functioning purporting to constitute a scientific explanation for what 'every parent already knows' about teenagers. The discussion helpfully challenges deceitful use of the adolescent/adult binary regarding reasoning and decision-making, and alternatively supports conceptualizing adolescents' abilities as quite distinct from those of children. This perspective is much to my liking, but it also provoked me to reflect on emerging discursive *similarities* between the brain stories around teenagers and much younger children regarding *non*cognitive skills.

Before MRI data demonstrated significant further restructuring in late childhood [Giedd et al., 1999], it had been widely believed that the 'first three years' were the brain's last major chance to 'hard-wire' key cognitive skills. Although this assumption had received serious critique [e.g., Bruer, 1999], these data expedited a conceptual/pedagogical shift of the 'use-it-or-lose-it' mantra to early adolescence. A decade later, however, with a focus on noncognitive skills such as empathy and self-control, a belief that hard-wiring of the brain in the earliest years is a highly predictive – and largely irremediable – determinant of adolescent and later behavior appears to have resurfaced.

In the UK, for example, the WAVE Trust's Report on the prevention of violence explains: 'The structure of the infant human brain is a crucial factor in the creation (or not) of violent tendencies because early patterns are established not only psychologically but at the physiological level of brain formation' [Hosking & Walsh, 2005, p. 18]. While 8 of 11 references cited in support predate Giedd et al. [1999], the report apparently also endorses the view that quality of the mother-child relationship impacts the infant brain to such an extent that it permanently molds capacity to enter all future relationships. In 2008, Labour and Conservative parliamentarians Graham Allen and Iain Duncan Smith collaborated to promote policies deemed essential to stemming the effects of 'unchecked dysfunction' in British society. They relied considerably on a graph (credited to the WAVE Trust) showing the brain's capacity to change as declining rapidly after birth to almost nothing by late childhood, contrasted with the rapidly rising cost with age of programs to 'change the brain' [Allen & Duncan Smith, 2008, p. 47]. Like WAVE, they adopted the notion of 'sensitive windows of time' for establishing certain skills and functions to argue that the best of current knowledge suggests that the window for emotional sensitivity and empathy lies within the first 18 months of life and is crucially shaped by the primary caregiver (p. 60). The ongoing authority of this report is acknowledged in more recent submissions to parliament on these issues, while in the recent review of best evidence from 'liberal think tank' *Centre Forum* offers yet more of the same:

> The brain is at its most flexible, or 'plastic,' early in life to accommodate a wide range of environments and interactions, but as the maturing brain becomes more specialized to assume more complex functions, it is less capable of reorganizing and adapting to new or unexpected challenges. Once a circuit is 'wired,' it stabilizes with age – it loses its plasticity – making it increasingly difficult to alter. … it is easier and more effective to influence a baby's developing brain architecture than to rewire parts of its circuitry in later childhood or adult years. [Paterson, 2011, pp. 21–22]

A similar position is gaining strength here in New Zealand. In June, the Office of the Prime Minister's Chief Science Advisor produced a major report addressing the perceived need for increasingly urgent action to combat various forms of undesirable adolescent risk-taking. While indicating it does not intend to imply that 'actions later in the life course are not justified or without benefit,' the report clearly interprets best evidence as pointing to 'the vital importance of the early life as a period for intervention, action and targeted prevention' [Gluckman, Low, & Franko, 2011, p. 27]. The director of the country's long-running Dunedin Multidisciplinary Health and Development Study, Richie Poulson, particularly endorses findings that the establishment of skills such as self-control in early childhood is highly predictive of physical health, substance dependence, and criminal offending outcomes [Moffitt et al., 2011; Poulson, 2011].

That prevention is better than cure is always an enticing argument. Nevertheless, what we are now coming to recognize as a seriously flawed teen brain discourse is espoused with similar conviction and enthusiasm, and these 'toddler brain' proposals require no less scrutiny. In September, a 2-day conference was held at the University of Kent's Centre for Parenting Culture Studies with these claims – described by keynote speaker Ellie Lee as 'the new phrenology' – as a central focus of debate (see http://blogs.kent.ac.uk/parentingculturestudies). Prior to the event, some participants made versions of their presentations available in the online magazine *spiked.* For example, Frank Furedi examined concurrent demotion of parental authority and ascendancy of parenting expertise – based of course on purely objective science 'so that only the prejudiced could possibly disagree with them' – and the relentless promotion of the recently discovered complexity of childrearing [Furedi, 2011], labeling the implied requirements for micromanaging early parenting as 'deft and dishonest manoeuvres.' Stuart Derbyshire, like Lee, roundly criticized UK reports (such as those cited above) whose authors have apparently accepted without question the hypothesis that, if major abnormalities are revealed in the brain scans of extremely severely deprived children, then *some* abnormalities will exist in any socially disadvantaged child [Derbyshire, 2011].

For a while, then, one almost-positive outcome of the ascendancy of the teen brain story was that it appeared to effectively undermine some popular essentialist beliefs about early childhood: now the wiring for being good at mathematics did *not* have to be completed by age 3! However, there seems to be an insatiable appetite for profoundly developmentalist explanations of human

competencies – particularly as fuelled by 'best evidence' from neuroscience – and while as yet teen and toddler brain supporters do not seem to be talking to each other much, if they start to do so there may be manufactured an overwhelmingly controlling discourse of demands for parents to navigate that makes the old Freudian minefield look even more like a walk in the park. Therefore, I suggest those of us who will be making use of Moshman's observations on adolescents should probably be keeping an equally close watch on what is being said about their baby brothers and sisters.

Monica A. Payne
Department of Human Development & Counselling, University of Waikato,
Hamilton, New Zealand

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Grasping Both the Normative Facts and the Social Positions Emerging from Conversation

Charis Psaltis's commentary of our article [Sorsana & Trognon, 2011] invites us to clarify the contribution of interlocutory logic to the analysis of the contextual determination of thinking in psychology. The methodological challenge consists in identifying the emergence of rationality without denaturing the complexity of the social and cognitive context in which it emerges or builds itself. Two ways of proceeding appear. According to Charis Psaltis, one could analyze the psychosocial actor by listing a set of properties that are likely to be added and based on 'the balance of a variety of sources of asymmetry of status (gender, age, ethnic origin, popularity, academic reputation, social class, inter alia)' [2011, p. 239]. In other words, an additive conception of interaction is suggested. However, work in ethnomethodology taught us that it does not work this way. And we mark our disagreement with Charis Psaltis's conception by assuming a systemic (or integrative) conception of interaction within which it is the set of the cognitive, social, and cultural properties that simultaneously appear because individuals are coupled with their environment, in particular, human environment. In semiotics emerging from a social interaction and via interlocutions, all the levels of analysis described by Doise [1982/1986] appear at the same time; they are inseparable. However, we can more or less disentangle them by interpreting them using our method of analysis.

Interlocutory logic is an endeavor that seeks to develop a process to grasp the general (for example, the acquisition of a physics formula), therefore belonging to Doise's [1982/1986] level 4, inside the singular, that is to say, in the unfolding process of production. In other words, the matter is to propose a set of methods that 'accompany' the unfolding thinking 'in acts.' And we recognize the same type of concern in research conducted by Inhelder and her colleagues: the microgenetic approach that she initiated clearly amounts to establishing the emergence of universal cognitive characteristics inside the singular subject. In order to understand how interlocutory logic

approaches social representations (level 4) and status and roles (positional level or level 3), it is necessary to reconsider the ontology of social psychology according to Doise [1982/1986]. Where is interlocutory logic located in this ontology? The sphere of activity of interlocutory logic is level 2. Level 2 is the 'order of the interaction' [Trognon & Batt, 2010]. Thus, in daily activities, thinking and social positions are accomplished at the same time that they are located intersubjectively. We renamed this order the 'dialogical order' so as to stress the fact that, in the specifically human form of the order of interaction, the *talk-in-interaction* plays a crucial role – too often ignored by traditional social psychology but extremely well highlighted by ethnomethodology and its lineage, the *conversational analysis.* This enables us to renew with problematics suggested by Mead and Vygotski in the first era of psychology. What is there exactly in the dialogical order? Essentially, *dynamics of relational couplings* (see enaction framework) *that generate intersubjectivity, under the terms of differences between individuals*. In the end, there are only *accomplishments* in the dialogical order. Their field is mainly made up of social representations (individuals, i.e., things, people), relations (i.e., norms), thus status and roles, and finally institutions. Conceptual representations (length, volume, etc.) and their properties – for example the famous Piagetian tasks of conservation – form a significant subset of social representations. This catalogue is not very systematic, but without any difficulty we can find Doise's [1982/1986] levels 3 and 4 in it.

In consequence, the contents of levels 3 and 4 are accomplished *in* level 2 [Trognon & Batt, 2010]. And so, these contents 'go from' the more or less regular relational couplings (see formats of interaction) to the psychosocial actors who enter these couplings. Here is what explains the *formative* function of level 2: it is in this order that the sociocultural positioning is recreated or even created, and in its historicity itself, it is in this order that the collective 'goes into' the individual, thanks to intersubjectivity. Concerning the social positions, as ethnomethodologists write:

> Rather than approaching relationships as a reality lying behind and influencing members face-to-face behavior, we can investigate them for how, in the course of the time, they are accomplished within everyday interaction by various speaking practices, including those involved in the production of topical talk. That is, the phenomenon of relationship can be located as a feature of conversational interaction, reflected in work done on the occasion of its display and recognition. [Maynard & Zimmerman, 1984, p. 305]

Published work using the framework of interlocutory logic presents a broad range of situations where social categories as well as social positions are built up in level 2 locally, and sometimes in an inventive way. For example, Trognon and Kostulski [1999] analyzed the transmission of information relating to patients in a hospital between the paramedic team (nurses and auxiliary nurses) who finishes their service and the team who takes over. Auxiliary nurses assert, and more precisely, answer questions while nurses ask questions and infer. The differences of status (Doise's [1982/1986] level 3 reflecting characteristics of level 4) are 'translated' (coded) into

differences of conversational roles and of discursive products. The social positioning is expressed at the semiotic level; it is on this level that it is objectified, and that interactants recognize it. By doing this, in their conversation, auxiliary nurses and nurses reconstitute simultaneously the cognitive schema (or model) of the diagnosis as well as the social schema (or organization chart) of the hospital with status and functions. To give another example, the interlocutory analysis presented by Larrue and Trognon [1993] allows us to understand how the status-role relation (level 3) implied by the rule that manages the speaking turn in a discussing group (level 4) *is accomplished and revealed* in a meeting of a political organization. Moreover, this study shows how a dyad, then a group, locally creates a directive communicational act, that is to say, a nonnatural sign from a gesture – interpreted as a request to stop the speaker's speech – following a process explained in Trognon and Batt [2010].

At level 2, the process of production-reproduction of the conceptual representations does not differ from that of the social representations *period*. However, because it relates to simpler objects, at least from the analysts' point of view, *who have scientific descriptions that are likely to be used as standards to analyze these objects,* the study and the exposure of the process of production-reproduction of the conceptual representations are easier. On this aspect, too, several studies carried out within the framework of interlocutory logic are available in English. For example, Trognon, Batt and Laux [2011] offered almost 'pure' descriptions of productions *in interaction* of formulae *derived/derivable from axiomatic reasoning*. Thus they offer us a basis from which to evaluate the part that each partner takes in the production of these formulae.

To do that, it is necessary to have a method of data analysis that is appropriate for its field of application. We think that interlocutory logic constitutes a first interesting step towards the realization of such a plan. The elementary components of interlocutory logic are *primary* sociocognitive elements. As such, *they cannot be divided*. It is exactly what the *F(P)* formula expresses, not an addition of a force and a proposition, but a *function* in which P is the *variable*. Because this variable is a *representation* and a force is a *goal,* it does not appear unreasonable to say that *F(P)* describes a process - *the representation is controlled by the action* - which is typical of natural language. Now, considering the set of the illocutionary goals, it is staring at us in the face that their great majority have to do with *interpersonal relations*, i.e., typical events of level 2. Even a simple objective description, an assertion, is fastened with an interpersonal relation. An assertion is an *affirmation*. It is always *intended for an interlocutor*. Nobody will be astonished to note that it is the same for the complex components of interlocutory logic.

Back to Our Illustration

Let us consider the debate between the two young girls – Audrey and Vanessa – in the proposed illustration in our article. The disagreement between the two girls, Vanessa and Audrey, is a fertile moment of the resolution process, in line with sociocognitive theory. First of all, it is a fertile moment from a cognitive point of view. Indeed, the resolution of their disagreement allow them to avoid the pitfall (or the trap) that usually exists for players – children as well as adults – to invent an additional rule consisting of avoiding blocking the large (brown) disk after it was released by putting the small (white) disk on it. It is a fertile moment from an interpersonal point of view, too. Indeed, from that moment we observe a kind of 'rebellion' from Audrey that will end in an inversion of leadership inside the dyad, Audrey directing Vanessa after being directed by her. Let us consider that more precisely.

From 1Va to 11Va, Vanessa takes the initiative five times; Audrey following the successive directive acts uttered by Vanessa. However, from 11Va, Audrey refuses to go on following her partner. She proposes an alternative that will be rejected by Vanessa. But Audrey persists, maintains her proposal (to put the small white disk on the large brown disk) and explains it (in order then to move the pink disk on the green one). The same previous exchange is reiterated, in which Audrey reiterates her proposal and represents it with more force 'suiting the action to the word.' While the beginning of the conversation was supported by complementary exchanges, symmetrical exchanges appear during which Audrey stresses the strength of her proposal. Then, while expressing that she has discovered something, Vanessa gives in to Audrey since she helps her to carry out her proposal. Audrey thus becomes the 'winner' of this disagreement. Moreover, she expresses her satisfaction. The interaction follows and ends in an optimal way (i.e., reaching the optimal solution) but this time under Audrey's direction. In the end, the children achieved the best outcome of their play: Vanessa informs the experimenter, confirmed by Audrey. It is clear that if Audrey had not protested, maybe the children would have built the tower on the right peg, but using more moves than necessary. Formative or not, the disagreement would obviously have been *at least an objective cause* of the success of the problem resolution. It could neither be an incidental phenomenon nor an event that is added simply to the cognitive process.

The argument that finally wins out is a valid argument, coherent according to the goal of the game (i.e., to move the disks by avoiding useless moves, that is to say, in a minimum of moves). Our method very precisely allows us to capture this moment of shared objectivity and logical functioning. In addition, our analysis is very much in symbiosis with what Piaget said in Beth and Piaget [1961/2010]: in order for a person to adopt an argument in a debate, it is not enough that this argument is (logically) valid, it is necessary that the (logical) validity has value of norm for him/her. We bring out Audrey's behavior: she asserts an argument whose validity is formally

demonstrable according to the rules of the game. It is an argument. An argument is a judgment that has a certain value, so it is the use of a norm in order to persuade/convince an opponent. We bring out Vanessa's behavior, too. She agrees to the proposition. It also is a behavior. Let us suppose that she accepted the argument 'just to keep Audrey happy.' She would have accepted the argument without understanding it, or she would have given an agreement by submission; in such a situation, the interaction would not therefore lose its formative value for Vanessa. Nevertheless, the course of the moves permitted by the application of Audrey's proposition could retrospectively convince Vanessa of the formal-objective validity of Audrey's proposition.

In the experiment from which the interaction between Audrey and Vanessa is extracted [Sorsana, 1997], results showed that affinity relationship (i.e., mutual positive relationship between two children) clearly produces effects on the process of joint resolution as well as on the children's performance. However, this conversational excerpt clearly shows that another relationship is accomplished that is more than a simple cognitive relationship between the two children. This analysis enables us to answer frankly and clearly two questions that Charis Psaltis asked us. What more does interlocutory logic bring to previous traditional analyses of experimental data produced in a three-step design (pretest/interactive versus individual phase/immediate and differed posttests)? How does interlocutory logic detect social factors concerned in any interaction? Giving Lewin a wink, we interrogate this question in an OuLiPo way: within an 'affine' relationship (i.e., a mutual positive relational choice to be and do something together), the sociopsychological 'turbine' of the interaction reaches its minimum 'engine speed' when the (happy) resolution of a sociocognitive conflict occurs. Therefore, the sociopsychological production does not stop, but remains with the state of tracks. We detect these tracks within the following exchange: [(17Va1-2, 18-19), 20Va, 21Au] = [(expressive acts expressing Vanessa's discovery, joint actions of moving the disks that satisfy Audrey's request), expressive act expressing Vanessa' ratification, Audrey's smile].

We have a good illustration of the fact that interpersonal relationships and cognitive acquisitions are embedded, as well as a good example of the descriptive effectiveness of interlocutory logic. Interlocutory logic is conceived to grasp this embedment of the objective matter (knowledge) in the intersubjective one (the relationship). It is precisely for this reason that, from a syntactic point of view, illocutionary acts such as they are defined in general semantics are fundamental symbols of illocutionary logic.

Conclusion

It is thus not true that we do not take into account the social variables in our work devoted to cognitive events. Simply, interlocutory logic applied to the process of cognitive acquisitions

emerging from several experimental data shows a modulated effectiveness of certain social factors. Sometimes their influence is not observed. Of course, we do not induce a general law, just as we do not conclude that they do not have any influence when statistical tests do not reveal it. Sometimes – as is the case of an affinity relationship – it is manifested that those social factors exert an influence on the dyad's cognitive success. Such an influence is not necessarily transferred, or not necessarily in the same way for each partner. However, asymmetry of knowledge does not presume any cognitive progress: Vanessa will obtain definitely higher performance than Audrey on the two post-tests (she solved the 4-disk tower in 16 moves vs. 24 moves made by Audrey; she performed the 3-disk- tower in an optimal way, that is to say in 7 moves, vs. 9 moves made by Audrey). Thus this example shows that there is both a social position and a position to the object problem that are accomplished simultaneously. As we have seen, other examples are available.

We conclude that if we want to progress in such a field of investigation, perhaps it would be necessary to enrich the data collection as well as the means of analyzing it. Initiated by Bärbel Inhelder and followed in the genetic social psychology framework, great progress was achieved in inventing the design of relevant experiments to study the formative functions of the dialogical order. However, great progress remains to be achieved to enrich the data collection produced by these original experimental designs. Behaviors that are accomplished in such designs should be systematically recorded and especially analyzed by adapted methods. By now, when considerable means are invested in order to highlight symmetries of the central nervous system mobilized by interlocutors engaged in a conversation, it would not be useless for psychology to build theoretical and methodological systems at least enabling it to refine its grain of analysis. Interlocutory logic is a system of this type and we hope to have shown that it makes it possible to usefully complete data provided by molar methods of analysis. We simply ask that this method of analysis be evaluated empirically by examining its claims.

Alain Trognon
University of Nancy 2, France

Christine Sorsana
Universities of Toulouse 2 and Nancy 2, France

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