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Boundary Crossing and Boundary Objects

Sanne F. Akkerman and Arthur Bakker

Utrecht University

Diversity and mobility in education and work present a paramount challenge that needs better conceptualization in educational theory. This challenge has been addressed by educational scholars with the notion of boundaries, particularly by the concepts of boundary crossing and boundary objects. Although studies on boundary crossing and boundary objects emphasize that boundaries carry learning potential, it is not explicated in what way they do so. By reviewing this literature, this article offers an understanding of boundaries as dialogical phenomena. The review of the literature reveals four potential learning mechanisms that can take place at boundaries: identification, coordination, reflection, and transformation. These mechanisms show various ways in which sociocultural differences and resulting discontinuities in action and interaction can come to function as resources for development of intersecting identities and practices.

KEYWORDS: boundary, boundary crossing, boundary object, dialogicality, learning theory.

I am conscious of myself and become myself only while revealing myself for another, through another, and with the help of another. . . . [E]very internal experience ends up on the boundary.

Bakhtin (1984, p. 287)

All learning involves boundaries. Whether we speak of learning as the change from novice to expert in a particular domain or as the development from legitimate peripheral participation to being a full member of a particular community (Lave & Wenger, 1991), the boundary of the domain or community is constitutive of what counts as expertise or as central participation. When we consider learning in terms of identity development, a key question is the distinction between what is part of me versus what is not (yet) part of me.

Boundaries are becoming more explicit because of increasing specialization; people, therefore, search for ways to connect and mobilize themselves across social and cultural practices to avoid fragmentation (Hermans & Hermans-Konopka, 2010). The challenge in education and work is to create possibilities for

participation and collaboration across a diversity of sites, both within and across institutions (Akkerman, Admiraal, & Simons, in press; Daniels, Edwards, Engeström, Gallagher, & Ludvigsen, 2010; Ludvigsen, Lund, Rasmussen, & Säljö, 2010).

Over the past decades, many scholars have come to study these challenges by employing the term *boundaries* (e.g., Bernstein, 1971; Engeström, Engeström, & Kärkkäinen, 1995; Star, 1989; Suchman, 1994). A boundary can be seen as a socio-cultural difference leading to discontinuity in action or interaction. Boundaries simultaneously suggest a sameness and continuity in the sense that within discontinuity two or more sites are relevant to one another in a particular way.

An example of boundaries can be found in teacher education programs that include periods of schoolwork (R. Edwards & Fowler, 2007; Tsui & Law, 2007). Alsup (2006) showed how student teachers can face different pedagogical values. Such sociocultural differences in values between a teacher education program and a secondary school can cause discontinuity in the sense that the student teachers experience role or perspective changes between sites as challenging. At the same time, sameness and continuity reside in the fact that both sites are concerned with pedagogy and with the learning process of the student teacher.

In response to challenges of facing boundaries, education scholars have become interested in the ways in which continuity in action or interaction is established despite sociocultural differences. Two concepts have been central in describing potential forms of continuity across sites: *boundary crossing* and *boundary objects*. Although *boundary crossing* usually refers to a person's transitions and interactions across different sites (Suchman, 1994), *boundary objects* refers to artifacts doing the crossing by fulfilling a bridging function (Star, 1989). Examples of boundary objects are a teacher portfolio as a means by which both the mentor and the school supervisor are able to track the development of the student teacher in teacher education and a patient record that is used by different departments and institutes in medical care (Paterson, 2007).

According to Engeström et al. (1995), boundary crossing is "a broad and little-studied category of cognitive process" (p. 321). Since 1995, however, the concepts of boundary crossing and boundary objects have been used in complementary ways by many scholars in educational sciences and educational psychology. In ERIC and PsycINFO we found a total of 21 different works published in or before 1995 in which there is a reference to boundary object(s) and/or boundary crossing. The years 2007, 2008, and 2009 show 101, 109, and 113 publications, respectively, using the terms, indicating the current interest in the topic.

A review of the literature on boundary crossing and boundary objects seems timely. The concepts have now become an explicit part of two well-known learning theories: cultural historical activity theory on expansive learning (Engeström, 1987) and situated learning theory on communities of practice (Wenger, 1998), both stressing how boundaries carry potential for learning. The claims on boundaries and learning made in the literature, although perhaps appealing, are often general in nature, and the literature hardly explicates how or what kind of learning is taking place. In this article we review literature on boundary crossing and boundary objects to determine its current insights into learning potentials of boundaries. To frame the review, we first describe how educational and related sciences came to focus on boundaries and their learning potential.

The Centrality of Boundaries

In the following we elaborate on the concepts of boundary crossing and boundary objects, sketch how and why these concepts resonate with a broader movement in the social sciences, and propose how this is a new strand of literature.

The Concepts of Boundary Crossing and Boundary Objects

Education research mostly studies learning within boundaries of practices, focusing on particular groups of people or on certain domains of expertise. Along with new understandings of work, the emphasis on bounded and singular domains has been challenged. Star (1989; Star & Griesemer, 1989), Suchman (1994), and Engeström et al. (1995) found that various types of professional work (science, technology design, and teaching) are heterogeneous in that they involve multiple actors representing different professional cultures. In line with studies of professional work, Phelan, Davidson, and Cao (1991) found how adolescents cross boundaries, in their case among family, peers, and school. Hence, working and learning are not only about becoming an expert in a particular bounded domain but also about crossing boundaries.

The term *boundary crossing* was introduced to denote how professionals at work may need to “enter onto territory in which we are unfamiliar and, to some significant extent therefore unqualified” (Suchman, 1994, p. 25) and “face the challenge of negotiating and combining ingredients from different contexts to achieve hybrid situations” (Engeström et al., 1995, p. 319). Star (1989; Star & Griesemer, 1989) introduced the concept of boundary object to indicate how artifacts can fulfill a specific function in bridging intersecting practices. Boundary objects are those objects that

both inhabit several intersecting worlds and satisfy the informational requirements of each of them. . . . [They are] both plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites. They are weakly structured in common use, and become strongly structured in individual site use. (Star & Griesemer, 1989, p. 393)

Star and Griesemer found that the work of scientists during the development of a natural history museum required the collaboration of many actors (university administrators, professors, research scientists, curators, amateur collectors, private sponsors, members of scientific clubs, etc.). They attributed the successful pursuit of the research to the generation of a series of boundary objects such as data records and lists of species for collecting and describing insects.

Along with reception of these two concepts in the educational sciences, many different terms have emerged to refer to ways in which continuity across sites can be established, such as brokering, boundary interactions, boundary practices, and boundary zones. In the next section we discuss the background of the increasing interest in boundaries.

Background of the Interest in Boundaries

The growing interest in boundaries during the past decades should be understood against the background of two developments in the social sciences. First,

the interest in boundaries goes together with the study of larger units of analysis. Star and Griesemer (1989) stated the need for ecological analysis that includes analyzing the various institutions and different viewpoints of actors involved to understand how boundaries are encountered and crossed (see also Clarke & Star, 2007). Likewise, Engeström, Engeström, and Vähäaho (1999) showed that studying boundary crossing requires an analysis of all the loosely connected systems involved. This extended scope of analysis has been an explicit part of what is referred to as the third generation of cultural historical activity theory (CHAT), which states that two activity systems are the minimal unit of analysis (Engeström, 2001; Roth & Lee, 2007). CHAT represents a theoretical tradition that can be traced back to the works of Vygotsky (1978; 1934/1986) and his contemporaries, conceptualizing individual goal-directed actions in the frame of the larger collective system of activity from which these actions derive their meaning (Roth & Lee, 2007). The extended analysis beyond one practice is visible in different social scientific areas. For example, in organizational research there is increasing interest in the role of maintaining and crossing organizational boundaries (Heracleous, 2004; Lamont & Molnár, 2002; Paulsen & Hernes, 2003), and in group psychology there is increasing interest in the collaborative processes of cross-site (e.g., interdisciplinary or interteam) groups (Yoo & Kanawattanachai, 2001).

Second, on a more paradigmatic level, studies on boundaries seem to represent a new fine-grained appreciation of diversity. Lamont and Molnár (2002) noted in a short review of the literature that boundaries are discussed in a wide variety of social sciences to investigate how markers of difference are created, maintained, or contested at many different levels of institutionalization and categorization. Nevertheless, they indicate that researchers who draw on the concept of boundaries are largely unaware of studies of boundaries beyond their own specialties and across the social sciences. R. Edwards and Fowler (2007) argued that the increasing interest in boundaries is a result of a growing attempt of social theory, influenced by postmodernism, poststructuralism, postcolonialism, and feminism, to focus on the marginal and the decentered as alternatives to discourses of power of the center.

The paradigmatic shift can be seen in, for example, the way in which communication and the human mind are profoundly reconceptualized. In communication theories, several scholars (Lotman, 1990; Wertsch & Toma, 1995) have begun to argue against the basic and commonly held presupposition that communication is a transmission process that works best in situations of sameness in the minds of people. In contrast, they emphasize how words naturally mean different things to different people. Several authors (Bhabha, 1990; Soja, 1996) have called attention to the way in which intersections of cultural practices open up *third spaces* that allow negotiation of meaning and *hybridity*—that is, the production of new cultural forms of dialogue (Gutiérrez, Rymes, & Larson, 1995). In a different field of social theory, social psychology, the human mind is no longer studied solely in terms of a unified subject but as a self that is multiple, discontinuous, and inherently related to individual and generalized others (Akkerman & Meijer, 2011). Hence, it is more widely accepted to think in terms of a decentered self (Gergen, 1994) or dialogical self that continuously negotiates and strives to synthesize different subidentities (Hermans & Kempen, 1993). Accordingly, boundaries within

the self have become a focal point of interest of several psychologists (e.g., Marková, 2006; Valsiner, 2007).

What Is New for Educational Science?

An interesting question emerges concerning the extent to which the interest in boundaries is new for educational science. The educational notion that most closely approaches the idea of looking beyond single and singular domains and practices is the notion of transfer. Reflecting on various approaches to transfer throughout the history of educational sciences, Säljö (2003) reminds us that transfer has been a concept for studying what is learned and for questioning how something learned in one task or context is applied in another task or context.

The literature on boundary crossing and boundary objects has a different focus than the literature on transfer in various ways. Although transfer is mostly about onetime and one-sided transitions, primarily affecting an individual who moves from a context of learning to one of application (e.g., from school to work), concepts of boundary crossing and boundary objects are used to refer to ongoing, two-sided actions and interactions between contexts. These actions and interactions across sites are argued to affect not only the individual but also the different social practices at large. Following ideas underlying boundary crossing, we find recent attempts to reconceptualize transfer (e.g., Beach, 1999; Konkola, Tuomi-Gröhn, Lambert, & Ludvigsen, 2007; Tuomi-Gröhn, Engeström, & Young, 2003).

A second important difference between transfer studies and literature on boundary crossing and boundary objects relates to the way in which diversity is appreciated. Although the transfer literature approaches sociocultural differences as problematic, something that should be overcome or avoided, the boundary literature initially values such differences. In the latter perspective, the emphasis is on overcoming discontinuities in actions or interactions that can emerge from sociocultural difference rather than overcoming or avoiding the difference itself. The process of reestablishing action or interaction is seen as a resource for learning. Claims on the potentials of boundaries have become an explicit part of learning theories developed by Wenger and by Engeström. Although Wenger (1998) took single communities of practice as his main unit of analysis, he explicitly argued that learning at the boundaries is necessary if communities of practice do not want to lose their dynamism and become stale. In the third generation of CHAT, boundaries, in the form of contradictions between activity systems, are seen as vital forces for change and development (Roth & Lee, 2007).

We propose that *dialogicality* is a useful theoretical concept to underpin and understand these claims on learning. Marková (2003) described dialogicality as the ontological characteristic of the human mind to conceive, create, and communicate about social realities through mutual engagement of the ego (i.e., self or selves) and the alter (i.e., others). The notion of dialogicality goes back to the philosophy of Bakhtin (e.g., 1981, 1986), who, as Marková's historical review of social psychology indicates, was one of the first to state clearly that all understanding and all symbolic activity of humans are "founded on 'dialogue' between different minds expressing multitudes of multivoiced meanings" (p. 83).

Bakhtin's basic line of reasoning was that others or other meanings are required for any cultural category to generate meaning and reveal its depths:

Contextual meaning is potentially infinite, but it can only be actualized when accompanied by another (other's) meaning, if only by a question in the inner speech of the one who understands. Each time it must be accompanied by another contextual meaning in order to reveal new aspects of its own infinite nature (just as the word reveals its meanings only in context). (Bakhtin, 1986, pp. 145–146)

This Bakhtinian notion of dialogicality comes to the fore in the various claims on the value of boundaries and boundary crossing for learning: learning as a process that involves multiple perspectives and multiple parties. Such an understanding is different from most theories on learning that, first, often focus on a vertical process of progression in knowledge or capabilities (of an individual, group, or organization) within a specific domain and, second, often do not address aspects of heterogeneity or multiplicity within this learning process. Nevertheless, the claims on boundaries as a dialogical learning resource do not specify the exact mechanisms taking place.

We contend that the increasing literature on boundary crossing and boundary objects reflects a potentially new horizon in educational theory. First, this literature focuses explicitly on boundaries rather than on the centers of particular domains or communities; and second, it claims boundaries to be potential learning resources rather than barriers. To investigate both of these aspects in more detail, two questions are central to the literature review: (a) What is the nature of boundaries? and (b) What dialogical learning mechanisms take place at boundaries?

Method

We conducted a literature search in ERIC and PsycINFO in three waves (May 2008, November 2009, and November 2010) with *boundary object(s)* and *boundary crossing* as terms used in one of all fields, without restrictions regarding the source, language, type, or year of reference. This resulted in an overall list of 704 unique hits. From this list we selected 187 references based on two rules: (a) boundary objects and/or boundary crossing are used as central analytical concepts in theoretical or empirical analyses and (b) the study focuses on learning, understood in its broadest sense (i.e., including an interest in change and development). The latter rule mainly implied that we excluded studies in therapeutic contexts where boundary crossing refers to ethical problems between therapists and patients. The selection took place based on abstracts and, in cases of doubt, on full texts. Five of the selected references could not be retrieved as full texts, leading to a final number of 181 studies for review.

For the review, the full texts were first read and coded on paper according to contextual information (specific domain, theoretical underpinnings) and conceptual information: boundary terms, implicit or explicit definitions, visual representations of boundaries, critical examples of boundary phenomena, and claims and findings regarding boundary phenomena. The contextual information of the studies was scrutinized for determining different domains in which boundaries are encountered. The conceptual information was analyzed regarding the nature of the boundary (Question a) and the learning mechanisms taking place at the boundary (Question b). As to the first question, we considered all descriptions of boundaries and the way they play out for people and in boundary objects. As to the second question, we analyzed what processes were described as being the basis for the learning intended.

Results

In the first part of the Results section we briefly discuss the different domains within and between which boundaries are encountered. In the second and third part of this section we consider the two research questions, respectively observing that *boundaries are ambiguous* in nature and describing *four dialogical learning mechanisms*.

Boundaries Within and Across Domains

The review revealed how boundaries are encountered within and between the domains of work, school, and everyday life. Appendix A gives an overview of the focus of the studies reviewed. Most studies focused on *boundaries within work*, discussing how groups and individual professionals with different expertise, tasks, or cultural backgrounds collaborate during work. Although the reviewed literature covers studies within many different professional domains, four specific domains are more prominently represented: science and academia, health care, technology and design, and teaching. Boundaries can be expected in these professional domains because of a high degree of specialization and a need for interdisciplinary and cross-sectional work.

A much smaller number of studies focus on *boundaries within school*. This literature covers secondary and further education and includes one study in the context of primary education. Most of these studies are concerned with boundaries between discourses and perceptions of students on one hand and discourses and perceptions of teachers and/or the school on the other. For example, objects of study are differences between the academic literacy and the hybrid language practice of students (Gutiérrez, 2008) or cultural differences in terms of institutionalized versus context-bound mathematics (Hoyles, Noss, & Kent, 2004). Some studies report on boundaries that both teachers and students have to deal with, such as different perspectives on shared scientific subject matter (F. V. Christiansen & Rump, 2008).

A small number of studies in our review investigated *boundaries in everyday life*. The very diverse types of boundaries in this domain include not only boundaries encountered by adolescents between childhood and adulthood (Fine, 2004) but also boundaries resulting from racial categories (e.g., Telles & Sue, 2009) or from cultural categories that are worked on by different actors (e.g., Huyard, 2009).

Boundaries do occur not only within the domains of work, school, or everyday life but also between them. Studies that focus on the latter often investigate the way in which a single individual (student or professional) moves across these domains. After the publication of *Between School and Work* (Tuomi-Gröhn & Engeström, 2003), many studies appeared studying the way in which students encounter boundaries between school and work practice when graduating, doing internships, or combining the sorts of knowledge they learned at both sites. Boundaries are investigated between vocational education and vocational practice (e.g., Harrevelde & Singh, 2009), between secondary education and scientific practices (van Eijck, Hsu, & Roth, 2009), between teacher education and teaching practice in schools (e.g., Gorodetsky & Barak, 2008), and between higher education and workplaces (e.g., F. V. Christiansen & Rump, 2008). These studies consistently denote how students need to relate to different values and norms and find their own position.

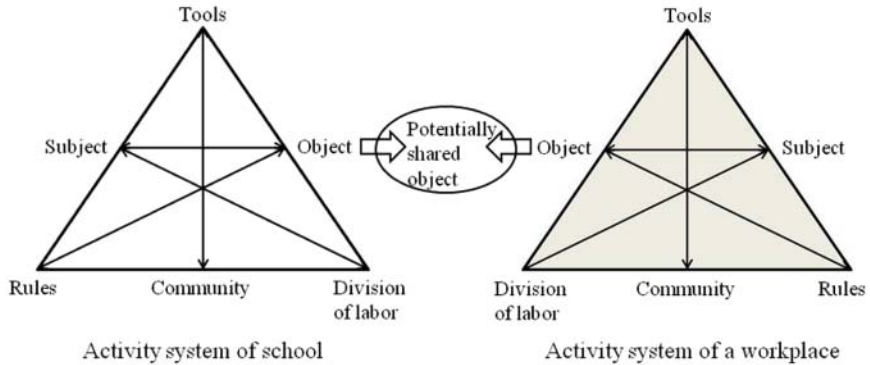


FIGURE 1. *Figure of school and workplace as integrating activity systems.* Reconstructed from Konkola, Tuomi-Gröhn, Lambert, and Ludvigsen (2007, p. 216), reprinted by permission of the publisher (Taylor & Francis Group, <http://www.informaworld.com>).

In remarkably similar ways, boundaries are reported between school and everyday life (e.g., family life, peer groups), stressing how the differences between these worlds and their discourses make it difficult for students to adapt, reorient, or integrate their experiences (Phelan et al., 1991). The few studies on work and everyday life show that professionals also face these challenges (e.g., Ashforth, Kreiner, & Fugate, 2000).

The Nature of Boundaries

Having discussed how boundaries can be encountered in and between different domains, we now address the nature of boundaries, focusing on similarities in how various studies conceptualized boundaries. One central feature emerging from the literature reviewed is that boundaries are always conceptualized in between two or more sites. This can be seen most explicitly in the figures of boundaries and boundary crossing in many studies. A typical example of such a visualization is Figure 1.

The figure is presented by the authors to indicate how both school and work have a potentially similar interest in educating students, yet each have different cultures. The boundary in the middle of two activity systems thus represents the cultural difference and the potential difficulty of action and interaction across these systems but also represents the potential value of establishing communication and collaboration.

To speak of boundaries as social scientific phenomena, we need to know how they play out. Let us therefore consider how the studies describe the people and objects that, figuratively speaking, play a central role at the boundary.

People at the boundary. We defined boundaries as sociocultural differences that give rise to discontinuities in interaction and action. Since it is individuals or groups of *people* that actually encounter discontinuities in their actions and interactions, it is worthwhile looking more closely at their experiences to understand what boundaries are about. This stands out most clearly in cases with only one or

a few persons doing the crossing. Terms such as *brokers*, *boundary crossers*, and *boundary workers* are often employed to denote them. The experiences of these people illustrate the ambiguity of boundaries. In the study by Fisher and Atkinson-Grosjean (2002), for example, managers of commercialization institutes are situated between industry and university. On one hand, they have a task of “building bridges” between both worlds (p. 463), being the means for connecting both sides. At the same time, however, these persons are held accountable in each world and must endure criticism “by academics for being too aligned with industry, and by industry for being too academic” (p. 453). Collinson (2006) describes the liminal (Turner, 1969; Van Gennep, 1909/1960) and ambiguous nature of the work of researcher administrators, who are sometimes positioned as administrative supporters while at other times are required to work as full colleagues in academic affairs. Focusing on identity formation of apprentices in trade vocation, Tanggaard (2007) characterizes their position at the boundary as that of marginal strangers “who sort of belong and sort of don’t” (p. 460). Williams, Corbin, and McNamara (2007) point out how this ambiguous role can lead to conflicted narratives. They describe how teachers in their role as school numeracy coordinators feel a conflict between a collegial discourse and accountability discourse. Although it is consistently reported how boundary-crossing individuals run the risk of not being accepted (e.g., A. Edwards, Lunt, & Stamou, 2010), Jones (2010) found in a historical analysis of boundary-crossing architects that people can receive appreciation for their innovative role in changing established professional practices in the longer term.

The accounts of single groups and individuals crossing boundaries show how they not only act as bridge between worlds but also simultaneously represent the very division of related worlds. On one hand they have a very rich and valuable position since they are the ones who can introduce elements of one practice into the other (cf. Wenger, 1998). On the other hand they face a difficult position because they are easily seen as being at the periphery, with the risk of never fully belonging to or being acknowledged as a participant in any one practice.

How can people manage this ambiguous position at the boundary? It generally calls for “personal fortitude” (Landa, 2008, p. 195). More specifically it requires people to have dialogues with the actors of different practices, but also to have inner dialogues between the different perspectives they are able to take on (Akkerman, Admiraal, Simons, & Niessen, 2006). Morse (2010b) describes how some leaders and organizations are successful precisely because of a boundary-crossing leadership style. D. Walker and Nocon (2007) make an explicit plea for stimulating “boundary-crossing competence,” which is the “ability to manage and integrate multiple, divergent discourses and practices across social boundaries” (p. 181). Likewise, Fortuin and Bush (2010) stress the importance of boundary skills.

Objects at the boundary. Not only people but also objects can play an essential role in crossing boundaries. In studies of boundary objects we also find the aforementioned ambiguity. On one hand, boundary objects are artifacts that articulate meaning and address multiple perspectives. As already indicated by the definition by Star and Griesemer (1989), boundary objects have different meanings in different social worlds but at the same time have a structure that is common enough to make them

recognizable across these worlds. However, it is not only interpretative flexibility that turns objects into boundary objects; boundary objects are organic arrangements that allow different groups to work together, based on a back-and-forth movement between ill-structured use in cross-site work and well-structured use in local work (Star, 2010). Hence, they are “a means of translation” (Star & Griesemer, 1989, p. 393) within a situation of multisite work relations and requirements.

Several of the studies reviewed report that artifacts can fail as boundary objects when they do not fully or rightfully capture multiple meanings and perspectives. For example, Hasu and Engeström (2000) found how supportive message boxes with system-related information about a medical technology were designed by system designers but failed to be supportive because the concerns and interpretations of users were not accounted for. Boundary objects are often designed to displace a part of communication or practice by anticipating multiple perspectives. Hunter (2008) described the successful development of policy documents that have a life of their own and function as tools for future communication and collaboration.

Despite design intentions, it is stressed that boundary objects are only partially communicative and, therefore, can never fully displace communication and collaboration. The risk with boundary objects is that they, especially because of their “material and processual nature” (Star, 2010, p. 604), appear to be self-contained objects. Wenger (1998) warned that “it is easy to overlook that they are in fact the nexus of perspectives, and that it is often in the meeting of these perspectives that artifacts obtain their meanings” (p. 108). Several scholars have described how additional information (e.g., about its inception, its history, and the surrounding negotiations) is needed to render boundary objects intelligible to other parties or for future use (e.g., C. P. Lee, 2007; Lutters & Ackerman, 2007). Furthermore, it has been argued that boundary objects can be perceived or used differently over time, at one time enabling communication and collaboration across sites, whereas at other times losing their boundary crossing function (Barrett & Oborn, 2010; Pennington, 2010).

Given the ambiguous nature of addressing and articulating multiple meanings while being simultaneously ill structured across sites, what are important considerations when designing boundary objects? J. K. Christiansen and Varnes (2007) make a connection between boundary objects as displacements and using these as obligatory passage points to which, in this case, project managers must direct their attention. This suggestion of boundary objects as displacements resonates with descriptions of boundary objects as black boxes. As black boxes, boundary objects tend to be invisible or taken-for-granted mediations that translate across sites but, when carefully considered or opened up, may provide learning opportunities (Williams & Wake, 2007).

Boundaries as ambiguous in nature. The descriptions of boundaries and of people and objects at the boundaries show an ambiguous nature. As an in-between or middle ground, the boundary belongs to *both* one world *and* another. It is precisely this feature that seems to explain how the boundary divides as well as connects sides (Kerosuo, 2001). However, the boundary also reflects a nobody’s land, belonging to *neither* one *nor* the other world. The ambiguity seems to cause what we call a *sandwich effect* for people or objects that cross or stand in between sites. On one

hand, they *enact* the boundary by addressing and articulating meanings and perspectives of various intersecting worlds. At the same time, these people and objects *move beyond* the boundary in that they have an unspecified quality of their own (neither–nor).

We contend that it is precisely this ambiguous nature that explains the interest in boundaries and boundary crossing as phenomena of investigation for education scholars. Both the enactment of multivoicedness (both–and) and the unspecified quality (neither–nor) of boundaries create a need for dialogue, in which meanings have to be negotiated and from which something new may emerge.

What Mechanisms Constitute the Learning Potential of Boundary Crossing?

To understand more precisely what the claimed learning potential at boundaries entails, we scrutinized the literature with respect to the descriptions provided of the learning processes. In line with this literature, we employ the term *learning* in a very broad sense, including new understandings, identity development, change of practices, and institutional development. We have discerned four mechanisms of learning at the boundary, which we summarize as identification, coordination, reflection, and transformation. In the following, each of these learning mechanisms is described with examples from the studies reviewed. Appendix B provides an overview of the mechanisms described in the studies reviewed.

Identification. In the literature we can identify studies that describe learning at the boundary in terms of identification. These studies all focus on boundary crossing as a process in which previous lines of demarcation between practices are uncertain or destabilized because of feelings of threat or because of increasing similarities or overlap between practices. The reported processes of identification entail a questioning of the core identity of each of the intersecting sites. This questioning leads to renewed insight into what the diverse practices concern. We found two common processes of identification described in the studies.

First, the identification processes occur by defining one practice in light of another, delineating how it differs from the other practice. This dialogical process of identification can be called *othering*. For example, some studies consider the challenge of individuals participating simultaneously in various institutionalized domains such as work and home (e.g., Ashforth et al., 2000) or such as school and home (e.g., Hughes & Greenhough, 2008). These studies denote that cultural constructions of work and home or school and home are drawn into question when people come to act in both worlds simultaneously, for example, when private phone calls interrupt work or when doing homework. In such instances, it becomes important to determine how both practices do and do not relate to one another.

Hughes and Greenhough (2008) provide a rich example of the tensions that can emerge when a student does mathematics homework with his mother's help. A range of personal and cultural identities is contested: the wider practice of homework; the school's mathematical practice and connected to this practice also the boy's school identity as a low-achieving pupil; the boy's home identity as someone wanting to play; and the mother's identity as helper, checker, and enforcer of homework and as someone with her own ambivalent feelings toward mathematics. The cultural differences of practices here lead to a negotiation of different identities, which do not harmoniously coexist.

The study by Considine (2006) of the challenged boundaries of universities shows how a process of identification by contesting or othering can also take place when it concerns institutional identity. He denotes that managers and employees of universities are finding it more and more difficult to explain what they do as distinctive from other systems that produce knowledge. He emphasizes more generally that “what establishes the system as a system are the distinctions actors use, and have others use, to define themselves, and this typically comes to light at the border of one system and another” (p. 257). In a similar way, Geiger and Finch (2009) describe how salespersons’ work is not a matter of crossing fixed boundaries but a matter of continuously redefining and thereby shaping boundaries of the seller and buyer markets.

A second, related process of identification that we found is the underlying need for *legitimizing coexistence*. Bogenrieder and van Baalen (2007) describe how people, when working simultaneously in different organizational groups, have to consider the interference between their multiple participations to be able to pursue each one and be accepted in this multiple membership by others in the respective groups. Hong and O (2009) provide an example of a failed attempt of identification, reporting how in-house staff and outsourcing technicians of a tertiary education institute were unable to come to terms with their distinct roles and responsibilities. In contrast, Huemer, Becerra, and Lunan (2004) describe how individual actors from different organizations may successfully define their differing organizational identities as well as their shared identities on a network level based on the project activities of this network. It should be noted that legitimating coexistence is often highly political and sensitive to those involved. Timmons and Tanner (2004) discuss how theater nurses feel threatened in their professional identity by the emergence of a new, slightly similar profession that was labeled as operating department practitioners. Reconstructing their own identities in light of the other was then a way for the nurses to preserve their profession.

What is typical in identification processes is that the boundaries between practices are encountered and reconstructed, without necessarily overcoming discontinuities. The learning potential resides in a renewed sense making of different practices and related identities.

Coordination. Several studies, particularly those studying the role of boundary objects as mediating artifacts, describe learning at the boundary as a matter of coordination. They analyze how effective means and procedures are sought allowing diverse practices to cooperate efficiently in distributed work, even in the absence of consensus (Star, 2010). In these cases, dialogue between diverse partners is established only as far as necessary to maintain the flow of work. Four processes can be discerned from the studies reporting actual or intended coordination effects.

First of all, coordination requires a *communicative connection* between diverse practices or perspectives (Landa, 2008), which can be established by instrumentalities (boundary objects) that are shared by multiple parties (J. K. Christiansen & Varnes, 2007). Paterson (2007) describes how an information structure can allow exchange of relevant patient information across different communities of practice in health care. Although interconnecting different actors, such instrumentalities are

read differently by different actors. Roth and McGinn (1998) discuss how school grades as boundary objects mean different things in different sites:

In schools, they are related to getting a good report card, graduating, and getting a diploma; in the admissions office of a university, the talk is about acceptance and probability of future success. Grades are the boundary objects that constitute the articulation between schools, colleges, and universities. (p. 410)

Second, some studies reveal that coordination entails *efforts of translation* between the different worlds. Fisher and Atkinson-Grosjean (2002) describe how the managers in industry liaison offices are charged with the role of translation, in their case, translation of research results into concrete commercial applications (p. 450). Such translation work can also be accomplished by the use of boundary objects and strongly relates to finding a balance in the aforementioned ambiguity of boundaries (neither–nor and both–and). Translations entail both an intersubjective ground as well as a diversity of possible understandings.

Third, coordination entails *enhancing boundary permeability* (cf. Bimber, Flanagan, & Stohl, 2005), so that one is not even aware of different practices simply because actions and interactions run smoothly without costs and deliberate choice. Boundaries can become permeable, for example, when employees manage to do homework without experiencing problematic discontinuities (Ashforth et al., 2000; Shumate & Fulk, 2004). These authors claim that the permeability of boundaries can be enhanced by repeatedly crossing different practices (in their case role transitions) as well as by means of rites or rituals (e.g., changing clothes or changing voice).

This latter example suggests a fourth process of coordination across boundaries—the importance of *routinization*, that is, finding procedures by means of which coordination is becoming part of automatized or operational practice. Studies adhering to coordination often emphasize boundary objects, in line with Star's original definition, as useful forms of translations to take place more or less without consensus or collaborative work between different groups of people. Lutters and Ackerman (2007) show in their case study of service engineers that boundary objects, although enhancing standardization and routinization, can still be malleable in each instance of their use and rely a great deal on situated interpretations of people with regard to the historic and current state of relations between groups.

The various processes of coordination across boundaries (establishing a communicative connection, efforts of translation, increasing boundary permeability, routinization) show how this learning mechanism of boundary crossing takes a different form than identification. The potential in the coordinative mechanism resides not in reconstructing but in overcoming the boundary, in the sense that continuity is established, facilitating future and effortless movement between different sites.

Reflection. In addition to identification and coordination, we find studies, often proposing or evaluating an intervention, that focus on the potential of the boundary in terms of *reflection*. These studies emphasize the role of boundary crossing in coming to realize and explicate differences between practices and thus to learn

something new about their own and others' practices. Williams and Wake (2007), for example, describe how, as college teachers, they visited workplaces together with their students. These visits made them aware of the differences between the mathematical genres in both college and work cultures, each having its own conventions and rules.

This reflective mechanism emphasizes not only comprehension but also the formulation of the distinctive perspectives. Hence, reflection involves what Boland and Tenkasi (1995) in their study called *perspective making*, that is, making explicit one's understanding and knowledge of a particular issue. Boland and Tenkasi discuss how cognitive maps and narrative structures are means to formulate and represent one's perspective, which in knowledge-intensive firms may "reflexively give access to the implicit and unstated assumptions" (p. 364). Similarly, Hoyles, Bakker, Kent, and Noss (2007) state that boundary crossing occurs "if these [boundary] objects facilitate communication between different activity systems by making explicit the knowledge and assumptions mobilized in the interpretation of the object" (p. 335).

A second process that is strongly emphasized in studies focused on reflection is that a boundary creates a possibility to look at oneself through the eyes of other worlds. With regard to their visits to workplaces, Williams and Wake (2007) also pointed to this second process:

On the other hand we noticed sometimes that the process has a reflexive impact on the workplace: workers who did not perhaps see their activity as mathematical were sometimes brought to see things our way, and thus look at their practice with a new, more mathematical perspective, e.g., the policeman who came to see the "error" of using an average of the averages in performance management, from a mathematical point of view. (p. 340)

The reflective impact of boundaries thus also entails what Boland and Tenkasi (1995) called *perspective taking*. They argued that boundary objects in knowledge intensive firms are artifacts that can serve as a perspective-taking experience for those who have the attitude of engaging the horizons of another thought world: "This taking of the other into account, in light of a reflexive knowledge of one's own perspective, is the perspective-taking process" (p. 362). Discussing cross-cultural business negotiations, White, Härtel, and Panipucci (2005) argue that a lack of such perspective taking can result in misunderstandings, which in turn negatively affect how the negotiation process is perceived and proceeds, with the risk of leading to major miscommunication. Taking another perspective is a way to begin to see things in a different light.

From a Bakhtinian point of view, both perspective making and perspective taking are dialogical and creative in nature. If it were merely duplication, it would not entail anything new or enriching. This generation of something new comes to the fore nicely in the study by Williams et al. (2007), who investigated teachers with an additional role as school numeracy coordinators. These teachers literally embody the boundary as they stand in between the research and development group at the university and the group of colleagues at school. Although initially experiencing a conflict between the role and discourse of colleague and of an accountable coordinator, one manager-teacher came to redefine both these perspectives, for example, perceiving management not as an activity conflicting with collegiality

but as an activity that involves making sure that colleague teachers will have an easier and better job. The authors point out that through this process, manager-teachers “come to reflexively understand and appreciate the exigencies of management” (p. 62). In this way, the demands of collegiality in school partly turn the audit (which tends to emphasize inspection, accountability, and blame) into a matter of dialogical inquiry for rethinking current structures, standards, and resources in the school.

A consequence of perspective making and perspective taking is that people’s ways of looking into the world are enriched so that one enriches one’s identity beyond its current status. This is clearly described in the study by George (1999), which discusses how students in a village high school in the Republic of Trinidad and Tobago face both traditional wisdom and scientific knowledge. According to George, boundary crossing strategies should “make it possible for students in traditional settings to have easier access to science through overt comparisons of their world view with that of science” (p. 94). She points out how both traditional wisdom and science originate from attempts of human beings to take care of themselves and to make sense of their world. Both concern public knowledge, have a personal side (to suit individual circumstances), and are historic systems in which current knowledge is based on knowledge of the past, whereas differences mainly concern what are considered to be appropriate mechanisms to attain health and a good relation with the environment. She reasons that both types of knowledge allow traditional students to evaluate the likely contribution of science to their lives.

Though this reflective mechanism might look similar to the mechanism of identification, they are different in focus. Where identification represents a focus on a renewed sense of practices and a reconstruction of current identity or identities, reflection results in an expanded set of perspectives and thus a new construction of identity that informs future practice.

Transformation. A fourth learning mechanism described in the literature can be summarized as transformation (see Appendix B for an overview). Similar to studies describing reflection, studies describing transformation often investigate the effects of interventions. Transformation leads to profound changes in practices, potentially even the creation of a new, in-between practice, sometimes called a boundary practice.

The studies that describe transformation processes consistently start with describing the *confrontation* with some lack or problem that forces the intersecting worlds to seriously reconsider their current practices and the interrelations. If such a confrontation is not occurring, transformation cannot be expected. Buxton et al. (2005) reason that the potential of boundary objects often goes unrecognized and untapped because underlying cultural models remain implicit. They suggest that exploration and discussion of the boundary objects are needed to affect the discourses of participants over time. Akkerman et al. (2006) stress the same problem, having found that participants of a collaborative intercultural research project do not come to explore each others’ thought worlds. They conclude that the meaning-generating effect of diversity cannot be presupposed; only when cultural differences lead to discontinuities can these generate negotiation of meaning; hence, “group

members should be encouraged to perceive and treat each other as other persons and to render each other's arguments as strange and new" (p. 482). The findings of various scholars lead them to conclude something similar: Confrontation entails encountering discontinuities that are not easily surpassed.

Many of the studies describing transformation suggest that a confrontation with a boundary can be caused by a disruption in the current flow of work. For example, a breakdown of a patient measurement in the context of health care specialists using a new technological design leads to strong frustration; however, it also creates an opportunity for negotiating the technological design with the developers and thus for re-mediating the measurement activity and the division of labor within it (Hasu & Engeström, 2000). Following the ideas of second- and third-generation CHAT, these scholars denote that tensions and conflicts may represent structural contradictions within or between activity systems. It is argued that they can, therefore, be made productive for transformation of the systems. Besides disruptions in work flow, confrontation with important boundaries can also be caused by the appearance of a third perspective. In Kerosuo's (2001, 2004) studies, the story of the patient with a chronic or complex disease is deliberately introduced in meetings with specialists from different domains, departments, or institutions who are all involved in the same patient's case. The patient's story of their treatment compels the specialists to reconsider how they work because their current approach apparently does not lead to a complete and satisfying diagnosis and treatment of the disease. In the context of a classroom, Matusov et al. (2007) describe how teachers can contribute to the emergence of Creole communities with diverse and distinguished cultural groups by making explicit to the pupils when the teacher encounters a recursive interactional breakdown without offering a ready-made solution.

A second process in intended and reported transformations is *recognizing a shared problem space*, often in direct response to the confrontation. For the health care specialists this shared problem space is the health of the patient with a chronic or complex (rather than single) disease. For diverse and Creole classrooms this shared problem is the recurrent interactional breakdown that needs to be solved collaboratively.

It should be noted here that some of the studies we have reviewed (e.g., R. Edwards & Fowler, 2007) have come to use the term *boundary object* to refer to this shared problem space. Object then is understood, following cultural historical activity theories, as the motive for activity and, in these cases of boundary crossing, as the motive for shared activity between diverse systems of activity. This conceptualization of boundary object is very different from the original definition by Star and colleagues, in which object refers to mediating artifacts (in the form of signs or tools). This twofold meaning of boundary objects in CHAT can be explained, as boundary objects have been initially referred to by Engeström et al. (1995) in terms of Star's conceptualization of boundary objects, whereas in later, third-generation CHAT literature (Engeström, 2001) boundary objects have been pictured as shared motives of two or more activity systems. In the image of two interacting activity systems such as the one previously shown in Figure 1, boundary objects are thus either (in Star's sense) localized as similar artifacts in the upper triangle that mediate two or more systems or localized as

“the potentially shared or jointly constructed object” between two activity systems (Engeström, 2001, p. 136).

We propose that to prevent confusion in this new body of literature, boundary object should be restricted to its original conceptualization by Star (1989; Star & Griesemer, 1989). Nonetheless, the various CHAT-informed studies make an important contribution to the understanding of boundary crossing as a potential process of transformation: Transforming current practices is not without direction; it is motivated by and directed toward the problem space that binds the intersecting practices together. As such, boundaries and the crossing of boundaries mediate a deliberate target of change. Although in coordination the focus is on minimal dialogue between practices (dialogue is intended only inasmuch as needed to pursue collaborative work), in the transformation mechanism dialogue becomes the focal point of interest.

A third process in transformation is *hybridization*. Given a certain problem space, practices that are able to cross their boundaries engage in a creative process in which something hybrid—that is, a new cultural form—emerges. In hybridization, ingredients from different contexts are combined into something new and unfamiliar. This can take the shape of new tools or signs, such as the formation of a new concept (Engeström et al., 1995) or an analytical model (Postlethwaite, 2007). The hybrid result can also take the shape of a completely new practice that stands in between established practices, such as school–work partnerships (Konkola et al., 2007) or an interdisciplinary field of science (Palmer, 1999). In the latter case a new place with its own boundaries eventually evolves.

A fourth process found in the descriptions of transformation is the *crystallization* of what is created, denoting how transformation is a more extreme version of learning at the boundary than the previously described mechanisms. The reasoning is that it is one thing to create something hybrid at the boundary but quite another to embed it in practice so that it has real consequences. Crystallization can occur by means of what Wenger (1998) called reification, that is, to “congeal this experience into ‘thingness’” (p. 58). As already discussed, a boundary object is an example of reification. However, as argued by Macpherson and Jones (2008), it may not be enough for transformation to take place if new shared conceptions of activity are crystallized in the form of boundary objects:

There also has to be a pragmatic commitment to these new activities, which occur not through the object itself, but through the engagement the objects facilitate. . . . It is this object-centered activity that has the potential to renew existing organizational artifacts of production (tools), of work distribution (processes and divisions of labor) and of work regulation (norms and values). (pp. 192–193)

Crystallization also takes place by means of developing new routines or procedures that embody what has been created or learned. Gorodetsky and Barak (2008) describe how the emergence of a community of student teachers, schoolteachers, and teacher educators represents a successful form of boundary crossing because the teachers started to enact new ideas in their own teaching practices. Although the importance of crystallization is emphasized in many of the studies pointing at transformation processes, their empirical findings suggest it is rarely realized. This

proves how hard it is to transform practices at the boundary, something that can often be explained by considering the distinct cultural history of practices.

Some studies describing transformation denote a crucial fifth process: the importance of *maintaining uniqueness of the intersecting practices*. This may seem at odds with the hybridization described earlier. The ambivalent direction—creation and connection to a new hybrid field, but also maintaining the integrity of the familiar field—is reflected in the following quote from Palmer (1999) about the interdisciplinary work of scientists:

Interdisciplinary research requires a balance between established core knowledge and the infusion of new knowledge. As researchers explore new problem areas, they do not necessarily abandon their disciplinary concentrations. Most have dual or multiple agendas, building on a core research specialization as they transit into a newer hybrid area. (p. 250)

In this way, it seems that transformation into changed or new practices does not go without some level of reinforcement of the established practices, as happens in identification processes. A plausible argument underlying this ambivalence is that it is precisely the difference (in this case of distinct disciplines) that upholds the relevance and value of the intersecting practices to one another.

A last process required for transformation and reported by most studies is that *continuous joint work at the boundary* is required to preserve the productivity of boundary crossing. This is where transformation seems almost opposite to the coordination mechanism, where the focus is on achieving a way to cross practices without much effort or awareness (e.g., Bimber et al., 2005; Hasu & Engeström, 2000). More than in the other mechanisms, transformation involves real dialogue and collaboration between “flesh-and-blood partners” at either side of the boundary (Engeström et al., 1995, p. 333). This seems to be the basic motive to create what are known as boundary-crossing laboratories in which people from different systems of activity are invited to meet to discuss and work on shared problems at the boundary, with the researcher acting as a mirror confronting people with the problem they share (e.g., Kerosuo, 2001). In addition to difficulties with crystallization, insufficient continuous joint work at the boundary could explain the lack of finding lasting transformations throughout most of the empirical work that we reviewed. Discussing student teacher assessment schemes as boundary objects between schools and higher education institutions, A. Edwards and Mutton (2007) formulated this issue as follows:

Once the scheme has been worked on and it enters each system as a tool to be used within the system rather than a joint object to be worked on [between the systems], its potential to reconfigure practices may diminish. (p. 508)

This continuous joint work at the boundary is often described by the reviewed studies as a process of negotiation of meaning. Related to this point, Oswick and Robertson (2009) warn other scholars not to give merely positive accounts of processes of boundary crossing and the role of boundary objects in particular. Too often boundary objects are perceived and presented as knowledge-transforming devices developed and applied between collaborating parties with complementary interests where agreed outcomes and change are rendered coherent, desirable, and

achievable. Instead, they argue, boundary objects are often subject to political processes, having a mediating role for contrasting goals, possibly reinforcing power structures and occupational hierarchies.

In contrast with the other mechanisms, transformation can entail the emergence of new in-between practices. The various processes of transformation indicate how difficult it is to achieve but, if successful, also imply sustainable impact. Not surprisingly, most of the literature reviewed—particularly intervention studies—aims for this fourth type of dialogical learning mechanism at the boundary.

Conclusions and Discussion

In the introductory sections, we state that the emerging body of literature on boundary crossing and boundary objects urges us to look at learning across and between multiple social worlds and thus expands education research beyond the study of learning within single domains and practices. We have argued that this literature represents an understanding of learning that is grounded in the notion of dialogicality and thus inherently involves dialogue between multiple perspectives and parties without implying or seeking homogeneity. Our aim was to gain better insight into the claimed learning potential of boundaries, and we asked two questions: (a) What is the nature of boundaries? and (b) What dialogical learning mechanisms take place at boundaries?

In response to the first question, we found that boundaries have an ambiguous nature in that they are both—and as well as neither—nor phenomena at the same time. This ambiguous nature creates what we call a sandwich effect for boundary-crossing people and boundary objects. On one hand, these people and objects enact the boundary by addressing and articulating the multiple meanings and perspectives following from sociocultural diversity (representing both—and). At the same time, boundary objects and boundary-crossing people move beyond the boundary since they are not fully defined by this multivoicedness but rather are in a middle ground and have an often unspecified quality of their own (neither—nor). Both this multivoicedness and the unspecificity at boundaries trigger dialogue and negotiation of meaning, explaining why encounters of boundaries are often described not only as challenging but also as worthwhile to investigate in relation to learning.

In response to the second question, we analyzed the learning processes described in the studies and discerned four dialogical learning mechanisms of boundaries: (a) identification, which is about coming to know what the diverse practices are about in relation to one another; (b) coordination, which is about creating cooperative and routinized exchanges between practices; (c) reflection, which is about expanding one's perspectives on the practices; and, (d) transformation, which is about collaboration and codevelopment of (new) practices. These mechanisms and accordant processes are summarized in Table 1. Most of the studies did not explicitly frame their empirical cases in these terms, and the mechanisms could often be read only implicitly in their definitions, claims, findings, and conclusions. Likewise, the small group of studies emphasizing more than one of the four learning mechanisms did not explicitly distinguish them as such. The categorization presented in Table 1 is intended not as a complete or fixed model of learning at the boundary but as a conceptual means to facilitate the explication

TABLE 1

Overview of different mechanisms and according characteristic processes of boundary crossing

Dialogical learning mechanisms	Characteristic processes
Identification	Othering
Coordination	Legitimizing coexistence
	Communicative connection
	Efforts of translation
Reflection	Increasing boundary permeability
	Routinization
	Perspective making
Transformation	Perspective taking
	Confrontation
	Recognizing shared problem space
	Hybridization
	Crystallization
	Maintaining uniqueness of intersecting practices
	Continuous joint work at the boundary

of, and interdisciplinary dialogue about, the different ways in which scholars have approached learning at the boundary.

The categorization of the four mechanisms raises the question of how they relate to one another. Several things can be said about this. First, on a general level it seems that identification is about constructing and reconstructing boundaries, whereas the other mechanisms are more about transcending boundaries. Second, it seems that identification and reflection mechanisms mainly reflect meaning-oriented learning processes (at stake are perspectives and identities), whereas both coordination and transformation reflect more practice-based learning processes (at stake is activity). Third, the coordination mechanism seems opposite to transformation, as the former reflects a smooth, effortless, and routine process of people or objects moving back and forth between practices, whereas the latter involves confrontations and continuous joint work. Identification and reflection, both involving the explication and visibility of perspectives, seem conditional for transformation because in the latter boundaries need to be encountered and contested before being put to use for codeveloping practices.

Thinking in terms of these four mechanisms allows us to think in a more fine-grained way about boundary crossing and boundary objects. With respect to the concept of boundary objects, there is a clear tendency to focus on achieving coordination, which seems in line with the empirical way in which Star initially applied the concept. In a critique on the common usage of the concept, C. P. Lee (2007) stressed that boundary objects do not always “pass cleanly and unproblematically between communities of practices and satisfying the needs of all” (p. 313) but can come with socially negotiated and disruptive processes that give them meaning. Following Lee’s point, Pennington (2010) showed how boundary objects can have a function in minimizing the need for social interaction and collaboration (such as

in coordination) as well as a function in maximizing negotiation and mutual understanding of perspectives. In response to the tremendous literature on boundary objects, Star (2010) recently emphasized that her “initial framing of the concept was motivated by a desire to analyze the nature of cooperative work in the absence of consensus” (p. 604). Studies in our review all seem to be driven by a similar motive as Star’s. Nevertheless, the studies reviewed indicate that boundary objects not only can lead to coordination processes but also can be of value for processes of identification and reflection (e.g., Kynigos & Psycharis, 2009) and processes of transformation (e.g., Macpherson & Jones, 2008). Regardless of the learning mechanisms that boundary objects support, Star’s original definition is useful for distinguishing boundary objects from other types of objects. Researchers in this field would serve the community well by sticking to the original definition of boundary objects and using other names for other types of objects.

There is one conclusion that holds for all four of the mechanisms: Dialogical engagement at the boundary does not mean a fusion of the intersecting social worlds or a dissolving of the boundary. Hence, boundary crossing should not be seen as a process of moving from initial diversity and multiplicity to homogeneity and unity but rather as a process of establishing continuity in a situation of sociocultural difference. This holds also for the transformation mechanism, in which something new is generated in the interchange of the existing practices, precisely by virtue of their differences. This leaves open whether these practices, over time, develop a new core practice. This maintenance of diversity is precisely what is captured in the notion of dialogicality: “[D]ialogical antinomies both unite and divide, both estrange and appropriate, both orientate the self towards ideas and meaning of others as well as towards the self’s own ideas” (Marková, 2003, p. 97).

Future Research

We see two main directions that would help advance the research in this area. First, in response to the literature reviewed, we see the need for defining the boundary concept beyond that of a sensitizing concept. In this article we defined boundaries as *sociocultural differences leading to discontinuities in action and interaction*. We contend that this definition is in line with the reviewed studies, even though most did not define the boundary concept. Many studies seem to use the term *boundaries* when discontinuities are expected rather than empirically detected. This can lead to a problematic conceptualization of boundaries, namely, one that completely resides in the existence of sociocultural differences. Dialogue and transitions of people and objects across different communities testify against this. We move across different practices all the time, often without awareness. Continuity of actions and interactions thus turns such a notion of boundaries into an artificial one. We therefore stress that boundaries, as a meaningful analytic concept, are about sociocultural differences *leading to discontinuities* rather than about sociocultural diversity per se. Defining boundaries in this way, it becomes clear how boundaries are real in their consequences, yet it also makes clear that boundaries are malleable and dynamic constructs. Sociocultural differences can lead to discontinuities in action and interaction in various ways at various times, but these discontinuities can also be overcome, even if temporal and partial. We

should also note that vice versa, it is by means of discontinuities that sociocultural differences between practices are being defined and shaped.

Methodologically, the proposed definition of boundaries requires researchers to take not only a systemic or macro perspective, describing the sociocultural differences (e.g., cross-contextual analysis or historical formation of differences), but also a situated or micro perspective, describing who experiences a particular discontinuity in which interactions or actions. In this way, it becomes possible to study how sociocultural differences play out in and are being shaped by knowledge processes, personal and professional relations, and mediations, but also in feelings of belonging and identities.

Following from the previous point, a second worthwhile direction for research is to identify a set of methodological indicators or markers with which diversity as well as consequent discontinuities can be empirically detected. Wenger (1998) denoted how the boundaries of communities of practice can be “reified with explicit markers of membership, such as titles, dress, tattoos, degrees of initiation rites” (p. 104). One can also think of spatial markers within architecture and interior design, such as tables and walls that indicate who belongs where (e.g., some decades ago it was not uncommon for teachers to sit on a higher platform in the classroom, marking their authority). Kerosuo (2004) explicitly asks how boundaries can be traced, describing some verbal markers as fragile signals in social interaction. In her study on boundaries in health care, she found three types of verbal markers: metaphors of boundaries (such as fences, walls, limits), actors’ attributes and definitions of social relations (we vs. they), and references to different locations (locations of care in this context). Kerosuo maintains that boundaries may also be captured by temporal distinctions, for example, by working hours and activity schedules.

As a final point we stress that the main value of this emerging body of literature on boundary objects and boundary crossing resides in (a) a recognition and acknowledgment of increasing diversity in and between schools, work, and everyday life; (b) putting decentered or marginalized spaces of social organization at the center of researchers’ attention; and (c) perceiving boundaries not only as barriers to but also as potential resources for learning. At the same time, most of the literature has not explicitly defined its central concepts. As nicely articulated by R. Edwards and Fowler (2007), “[T]here is a sense in which these concepts have been as much subject to the boundary-making of conceptualizing practices, as they have challenged the boundaries themselves” (p. 108). One difficulty of this body of literature is that the scholars are scattered across highly diverse and more or less separate domains of study (as Appendix A shows). Nonetheless, they all share a similar interest, which creates the need for a more extensive, integrative discussion on boundaries from a multidisciplinary perspective (Heracleous, 2004). With this review we hope not only to have identified this body of literature in the field of educational theory but also to have stimulated educational scholars to move across the boundary of their own field of study.

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APPENDIX A

Overview of the studies in the different domains

Work (127)

Science and academia	18	Akkerman et al. (2006); Benn and Martin (2010); Broekkamp and van Hout-Wolters (2007); Considine (2006); R. Edwards and Fowler (2007); Fisher and Atkinson-Grosjean (2002); Goodwin (2005); Kynigos and Psycharis (2009); Lagesen (2010); Liebenberg (2009); Palmer (1999); Pennington (2010); Pierce (1999); Pohl et al. (2008); Postlethwaite (2007); Star (2005); Tate (2008); Zittoun et al. (2009)
Technology and design	14	Barcellini et al. (2009); Barrett and Oborn (2010); Broberg and Hermund (2007); Carlile (2002); Cohn et al. (2009); Hasu and Engeström (2000); Johannessen and Ellingsen (2009); Luna-Reyes et al. (2008); Massanari (2010); Neff et al. (2010); Paay et al. (2009); Puustinen et al. (2006); Veinot (2007); Whyte et al. (2008)
Health care and social work	14	Allen (2009); Engeström (2001); Heldal (2010); Huzzard et al. (2010); Kerosuo (2001, 2004); Kerosuo and Engeström (2003); Mitchell et al. (2010); Mørk et al. (2008); Paterson (2007); Schryer et al. (2009); Swan et al. (2002); Swan et al. (2007); Timmons and Tanner (2004)
Teaching	15	S. Andersson (2006); Cobb et al. (2003); Cobb et al. (2009); Cobb and McClain (2006); A. Edwards et al. (2010); Engeström (2008); Gorodetsky and Barak (2009); Kärkkäinen (2000); Landa (2008); Rasku-Puttonen et al. (2004); Soliday (1995); Stein and Coburn (2008); Venkat and Adler (2008); S. Walker and Creanor (2005); Williams et al. (2007)
General and other specific work domains	66	Allen-Collinson (2009); Bechky (2003); Behrend and Erwee (2009); Bogenrieder and van Baalen (2007); Boland and Tenkasi (1995); Burman (2004); Carlile (2002, 2004); Carlile and Rebentisch (2003); J. K. Christiansen and Varnes (2007); Collinson (2006); Crosby and Bryson (2010); Daniels (2004); Decuyper et al. (2010); Dillon (2008); Doherty et al. (2010); Donnelly (2009); Dulipovici (2009); Engeström (2004); Engeström et al. (1995); Engeström et al. (1997); Engeström and Sannino (2010); Falconer (2007); Faraj and Xiao (2006); Fenton (2007); Fleischmann (2007); Fuller et al. (2009); Gal (2008); Gasson (2005); Geiger and Finch (2009); Hall et al. (2002, 2005); Harris and Simons (2006); Hemetsberger and Reinhardt (2009); Hepso (2008); Hildreth et al. (2000); Hinds and Kiesler (1995); Hong and O (2009); Hoyles et al. (2007); Huemer et al. (2004); Hustad (2007); Jones (2010); Kellogg et al. (2006); Kent et al. (2007); Kim and King (2004); Landry et al. (2010); C. P. Lee (2007); Levina and Orlikowski (2009);

(continued)

APPENDIX A (continued)

		Lindgren and Wåhlin (2001); Lutters and Ackerman (2007); Macpherson and Jones (2008); Metiu (2002); Morse (2010a, 2010b); Nitzgen (2004); Nosek (2004); O'Mahony and Bechky (2008); Ordanini et al. (2008); Oswick and Robertson (2009); Rose-Anderssen et al. (2010); Scarbrough et al. (2004); Strübing (1998); Thurk and Fine (2003); Toiviainen et al. (2009); Werr et al. (2009); White et al. (2005)
School (12)		
Primary	1	Matusov et al. (2007)
Secondary	3	Buxton et al. (2005); Hoyles et al. (2004); Roth and McGinn (1998)
Tertiary and higher ed.	7	Cambridge (2008); F. V. Christiansen and Rump (2008); East (2009); Fortuin and Bush (2010); Gutiérrez (2008); Melles (2008); Zitter et al. (2009)
General	1	Young and Muller (2010)
Everyday life (11)		
	11	Bilici (2009); Brown and Gómez de García (2006); Fine (2004); Fleischmann (2003); Garcia and McDowell (2010); Hunter (2008); Huyard (2009); H. J. Lee (2009); Loveman and Muniz (2007); Miettinen (2006); Telles and Sue (2009)
School–work (17)		
Vocational education or training–work	4	Harreveld and Singh (2009); Konkola et al. (2007); Tanggaard (2007); Vähäsantanen et al. (2009)
Secondary education–work	1	van Eijck et al. (2009)
Teacher education–teaching	6	I. Andersson and Andersson (2008); A. Edwards and Mutton (2007); Finlay (2008); Gorodetsky and Barak (2008); Tsui and Law (2007); Yoon et al. (2006)
Higher education–work	3	Garraway (2010); Smeby and Vågan (2008); Williams and Wake (2007)
School–work general	3	Guile and Griffiths (2001); Hung and Chen (2007); Saunders (2006)
Work–everyday life (3)		
	3	Ashforth et al. (2000); Bimber et al. (2005); Shumate and Fulk (2004)
School–everyday life (11)		
	11	Clark (2007); R. Edwards et al. (2009); George (1999); Hughes and Greenhough (2008); Kisiel (2010); Leander (2002); Lund (2006); Phelan et al. (1991); D. Walker and Nocon (2007); Yamazumi (2006; 2009)

APPENDIX B

Categorization of reviewed studies

Identification (27)

Allen-Collinson (2009); Ashforth et al. (2000); Bilici (2009); Bogenrieder and van Baalen (2007); Burman (2004); Cohn et al. (2009); Considine (2006); A. Edwards et al. (2010); R. Edwards and Fowler (2007); Engeström et al. (1995); Engeström et al. (1997); Gal (2008); Garraway (2010); Geiger and Finch (2009); Hong and O (2009); Huemer et al. (2004); Hughes and Greenhough (2008); Jones (2010); Kynigos and Psycharis (2009); Leander (2002); Loveman and Muniz (2007); Metiu (2002); Mørk et al. (2008); Shumate and Fulk (2004); Timmons and Tanner (2004); Werr et al. (2009); Young and Muller (2010)

Coordination (60)

Allen (2009); Ashforth et al. (2000); Barcellini et al. (2009); Barrett and Oborn (2010); Behrend and Erwee (2009); Bimber et al. (2005); Brown and Gómez de García (2006); Carlile (2002, 2004); J. K. Christiansen and Varnes (2007); Clark (2007); Cobb et al. (2003); Considine (2006); Decuyper et al. (2010); Donnelly (2009); Dulipovici (2009); Falconer (2007); Faraj and Xiao (2006); Fisher and Atkinson-Grosjean (2002); Gal (2008); Garcia and McDowell (2010); Heldal (2010); Hepso (2008); Hinds and Kiesler (1995); Hoyles et al. (2004); Hunter (2008); Huyard (2009); Kärkkäinen (2000); Kellogg et al. (2006); Kerosuo and Engeström (2003); Lagesen (2010); Landa (2008); Landry et al. (2010); C. P. Lee (2007); Lutters and Ackerman (2007); Melles (2008); Metiu (2002); Neff et al. (2010); Nitzgen (2004); Nosek (2004); Ordanini et al. (2008); Paterson (2007); Pennington (2010); Phelan et al. (1991); Puustinen et al. (2006); Roth and McGinn (1998); Schryer et al. (2009); Shumate and Fulk (2004); Smeby and Vågan (2008); Star (2005); Stein and Coburn (2008); Swan et al. (2007); Thurk and Fine (2003); Timmons and Tanner (2004); Vähäsantanen et al. (2009); Veinot (2007); Williams and Wake (2007); Yakura (2002); Zitter et al. (2009); Zittoun et al. (2009)

Reflection (23)

S. Andersson (2006); Bechky (2003); Boland and Tenkasi (1995); Cambridge (2008); Carlile (2002); F. V. Christiansen and Rump (2008); Collinson (2006); Fleischmann (2003); George (1999); Hoyles et al. (2007); Kent et al. (2007); Kynigos and Psycharis (2009); H. J. Lee (2009); Liebenberg (2009); Loveman and Muniz (2007); Luna-Reyes et al. (2008); Mørk et al. (2008); Pierce (1999); Scott and Walsham (2005); Soliday (1995); White et al. (2005); Williams and Wake (2007); Yoon et al. (2006)

Transformation (92)

Akkerman et al. (2006); I. Andersson and Andersson (2008); Benn and Martin (2010); Bilici (2009); Broberg and Hermund (2007); Broekkamp and van Hout-Wolters (2007); Brown and Gómez de García (2006); Buxton et al. (2005); Carlile (2004); Carlile and Rebentisch (2003); Cobb et al. (2009); Cobb and McClain (2006); Crosby and Bryson (2010); Daniels (2004); Dillon (2008); Doherty et al. (2010); East (2009); A. Edwards and Mutton (2007); R. Edwards and Fowler (2007); Engeström (2001, 2004, 2008); Engeström et al. (1995); Engeström and Sannino (2010); Fenton (2007); Fine (2004); Finlay (2008); Fleischmann (2007); Fuller et al. (2009); Garraway (2010); Gasson (2005); Goodwin (2005); Gorodetsky and Barak (2008, 2009);

(continued)

APPENDIX B (continued)

Guile and Griffiths (2001); Gutiérrez (2008); Hall et al. (2002, 2005); Harreveld and Singh (2009); Harris and Simons (2006); Hasu and Engeström (2000); Hemetsberger and Reinhardt (2009); Hildreth et al. (2000); Hung and Chen (2007); Hustad (2007); Huzzard et al. (2010); Kerosuo (2001, 2004); Kim and King (2004); Kisiel (2010); Konkola et al. (2007); Macpherson and Jones (2008); Palmer (1999); C. P. Lee (2007); Levina and Orlikowski (2009); Lindgren and Wählin (2001); Lund (2006); Massanari (2010); Matusov et al. (2007); Metiu (2002); Miettinen (2006); Mitchell et al. (2010); Morse (2010a, 2010b); Mørk et al. (2008); O'Mahony and Bechky (2008); Oswick and Robertson (2009); Paay et al. (2009); Pennington (2010); Pohl et al. (2008); Postlethwaite (2007); Rasku-Puttonen et al. (2004); Rose-Anderssen et al. (2010); Saunders (2006); Scarbrough et al. (2004); Stein and Coburn (2008); Strübing (1998); Swan et al. (2002); Swan et al. (2007); Tanggaard (2007); Tate (2008); Telles and Sue (2009); Toiviainen et al. (2009); Tsui and Law (2007); van Eijck et al. (2009); Venkat and Adler (2008); D. Walker and Nocon (2007); S. Walker and Creanor (2005); Whyte et al. (2008); Williams et al. (2007); Yamazumi (2006, 2009)

Note. Some studies describe more than one dialogical learning mechanism and therefore appear in more than one category.

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References

- Akkerman, S. F., Admiraal, W., & Simons, P. R. J. (in press). Unity and diversity in a collaborative research project. *Culture & Psychology*.
- Akkerman, S., Admiraal, W., Simons, R. J., & Niessen, T. (2006). Considering diversity: Multivoicedness in international academic collaboration. *Culture & Psychology, 12*, 461–485.
- Akkerman, S. F., & Meijer, P. C. (2011). A dialogical approach to conceptualizing teacher identity. *Teaching and Teaching Education, 27*, 208–319.
- Allen, D. (2009). From boundary concept to boundary object: The practice and politics of care pathway development. *Social Science & Medicine, 69*, 354–361.
- Allen-Collinson, J. (2009). Negative “marking”? University research administrators and the contestation of moral exclusion. *Studies in Higher Education, 34*, 941–954.
- Alsop, J. (2006). *Teacher identity discourses. Negotiating personal and professional spaces*. Mahwah, NJ: Erlbaum.
- Andersson, I., & Andersson, S. B. (2008). Conditions for boundary crossing: Social practices of newly qualified Swedish teachers. *Scandinavian Journal of Educational Research, 52*, 643–660.
- Andersson, S. (2006). Newly qualified teachers' learning related to their use of information and communication technology: A Swedish perspective. *British Journal of Educational Technology, 37*, 665–682.
- Ashforth, B. E., Kreiner, G. E., & Fugate, M. (2000). All in a day's work: Boundaries and micro role transitions. *Academy of Management Review, 25*, 472–491.

- Bakhtin, M. (1981). Discourse in the novel (C. Emerson & M. Holquist, Trans.). In M. Holquist (Ed.), *The dialogical imagination* (pp. 259–422). Austin: University of Texas Press.
- Bakhtin, M. (1984). *Problems of Dostoevsky's poetics* (C. Emerson, Trans.). Minneapolis: University of Minnesota Press.
- Bakhtin, M. (1986). From notes made in 1970–71 (V. McGee, Trans.). In C. Emerson, & M. Holquist (Eds.), *Speech genres & other late essays* (pp. 132–158). Austin: University of Texas Press.
- Barcellini, F., Detienne, F., & Burkhardt, J. (2009). Participation in online interaction spaces: Design-use mediation in an open source software community. *International Journal of Industrial Ergonomics*, 39, 533–540.
- Barrett, M., & Oborn, E. (2010). Boundary object use in cross-cultural software development teams. *Human Relations*, 63, 1199–1221.
- Beach, K. (1999). Sequential transitions: A sociocultural expedition beyond transfer in education. *Review of Research in Education*, 24, 101–139.
- Bechky, B. A. (2003). Sharing meaning across occupational communities: The transformation of understanding on a production floor. *Organization Science*, 14, 312–330.
- Behrend, F. D., & Erwee, R. (2009). Mapping knowledge flows in virtual teams with SNA. *Journal of Knowledge Management*, 13(4), 99–114.
- Benn, S., & Martin, A. (2010). Learning and change for sustainability reconsidered: A role for boundary objects. *Academy of Management Learning & Education*, 9, 397–412.
- Bernstein, B. (1971). *Class, codes and control*. London, UK: Routledge.
- Bhabha, H. K. (Ed.). (1990). *Nation and narration*. London, UK: Routledge.
- Bilici, M. (2009). *Finding Mecca in America: American Muslims and cultural citizenship* (Unpublished doctoral dissertation). University of Michigan, Ann Arbor.
- Bimber, B., Flanagin, A. J., & Stohl, C. (2005). Reconceptualizing collective action in the contemporary media environment. *Communication Theory*, 15, 365–388.
- Bogenrieder, I., & van Baalen, P. (2007). Contested practice: Multiple inclusion in double-knit organizations. *Journal of Organizational Change Management*, 20, 579–595.
- Boland, R. J., & Tenkasi, R. V. (1995). Perspective making and perspective taking in communities of knowing. *Organization Science*, 6, 350–372.
- Broberg, O., & Hermund, I. (2007). The OHS consultant as a facilitator of learning in workplace design processes: Four explorative case studies of current practice. *International Journal of Industrial Ergonomics*, 37, 810–816.
- Broekkamp, H., & van Hout-Wolters, B. (2007). The gap between educational research and practice: A literature review, symposium, and questionnaire. *Educational Research and Evaluation*, 13, 203–220.
- Brown, K., & Gómez de García, J. (2006). Linguistic research meets cultural-historical theory. *Mind, Culture, and Activity*, 13, 311–329.
- Burman, E. (2004). Boundary objects and group analysis: Between psychoanalysis and social theory. *Group Analysis*, 37, 361–379.
- Buxton, C., Carlone, H., & Carlone, D. (2005). Boundary spanners as bridges of student and school discourses in an urban science and mathematics high school. *School Science and Mathematics*, 105, 302–313.
- Cambridge, D. (2008). Universities as responsive learning organizations through competency-based assessment with electronic portfolios. *Journal of General Education*, 57(1), 51–64.

- Carlile, P. R. (2002). A pragmatic view of knowledge and boundaries: Boundary objects in new product development. *Organization Science*, 13, 442–455.
- Carlile, P. R. (2004). Transferring, translating, and transforming: An integrative framework for managing knowledge across boundaries. *Organization Science*, 15, 555–568.
- Carlile, P. R., & Rebentisch, E. S. (2003). Into the black box: The knowledge transformation cycle. *Management Science*, 49, 1180–1195.
- Christiansen, F. V., & Rump, C. (2008). Three conceptions of thermodynamics: Technical matrices in science and engineering. *Research in Science Education*, 38, 545–564.
- Christiansen, J. K., & Varnes, C. J. (2007). Making decisions on innovation: Meetings or networks? *Creativity and Innovation Management*, 16, 282–298.
- Clark, K. R. (2007). *Charting transformative practice: Critical multiliteracies via informal learning design* (Unpublished doctoral dissertation). University of California, San Diego.
- Clarke, A. E., & Star, S. L. (2007). The social worlds framework: A theory/methods package. In E. Hackett, O. Amsterdamska, M. Lynch, & J. Wacjman (Eds.), *Handbook of science and technology studies* (pp. 113–137). Cambridge, MA: MIT Press.
- Cobb, P., & McClain, K. (2006). The collective mediation of a high-stakes accountability program: Communities and networks of practice. *Mind, Culture, and Activity*, 13, 80–100.
- Cobb, P., McClain, K., de Silva Lamberg, T., & Dean, C. (2003). Situating teachers' instructional practices in the institutional setting of the school and district. *Educational Researcher*, 32(6), 13–24.
- Cobb, P., Zhao, Q., & Dean, C. (2009). Conducting design experiments to support teachers' learning: A reflection from the field. *Journal of the Learning Sciences*, 18, 165–199.
- Cohn, M. L., Sim, S. E., & Lee, C. P. (2009). What counts as software process? Negotiating the boundary of software work through artifacts and conversation. *Computer Supported Cooperative Work*, 18, 401–443.
- Collinson, J. A. (2006). Just “non-academics”? Research administrators and contested occupational identity. *Work, Employment and Society*, 20, 267–288.
- Considine, M. (2006). Theorizing the university as a cultural system: Distinctions, identities, emergencies. *Educational Theory*, 56, 255–270.
- Crosby, B. C., & Bryson, J. M. (2010). Integrative leadership and the creation and maintenance of cross-sector collaborations. *Leadership Quarterly*, 21, 211–230.
- Daniels, H. (2004). Cultural historical activity theory and professional learning. *International Journal of Disability, Development and Education*, 51, 185–200.
- Daniels, H., Edwards, A., Engeström, Y., Gallagher, T., & Ludvigsen, S. R. (2010). *Activity theory in practice: Promoting learning across boundaries and agencies*. London, UK: Routledge.
- Decuyper, S., Dochy, F., & Van den Bossche, P. (2010). Grasping the dynamic complexity of team learning: An integrative model for effective team learning in organisations. *Educational Research Review*, 5, 111–133.
- Dillon, P. (2008). A pedagogy of connection and boundary crossings: Methodological and epistemological transactions in working across and between disciplines. *Innovations in Education and Teaching International*, 45, 255–262.
- Doherty, N., Dickmann, M., & Mills, T. (2010). Mobility attitudes and behaviours among young Europeans. *Career Development International*, 15, 378–400.

- Donnelly, R. (2009). Career behavior in the knowledge economy: Experiences and perceptions of career mobility among management and IT consultants in the UK and the USA. *Journal of Vocational Behavior*, 75, 319–328.
- Dulipovici, A. M. (2009). *Exploring IT-based knowledge sharing practices: Representing knowledge within and across projects* (Doctoral dissertation). Retrieved from Dissertation Abstracts database. (2009-99191-120)
- East, K. (2009). Content: Making it a boundary object in the college classroom. *College Teaching*, 57, 119–125.
- Edwards, A., Lunt, I., & Stamou, E. (2010). Inter-professional work and expertise: New roles at the boundaries of schools. *British Educational Research Journal*, 36, 27–45.
- Edwards, A., & Mutton, T. (2007). Looking forward: Rethinking professional learning through partnership arrangements in initial teacher education. *Oxford Review of Education*, 33, 503–519.
- Edwards, R., & Fowler, Z. (2007). Unsettling boundaries in making a space for research. *British Educational Research Journal*, 33, 107–123.
- Edwards, R., Ivanič, R., & Mannion, G. (2009). The scrumpled geography of literacies for learning. *Discourse: Studies in the Cultural Politics of Education*, 30, 483–499.
- Engeström, Y. (1987). *Learning by expanding. An activity-theoretical approach to developmental research*. Helsinki, Finland: Orienta-Konsultit.
- Engeström, Y. (2001). Expansive learning at work: Toward an activity theoretical reconceptualization. *Journal of Education and Work*, 14, 133–156.
- Engeström, Y. (2004). New forms of learning in co-configuration work. *Journal of Workplace Learning*, 16, 11–21.
- Engeström, Y. (2008). *From teams to knots: Activity-theoretical studies of collaboration and learning at work*. Cambridge: Cambridge University Press.
- Engeström, Y., Engeström, R., & Kärkkäinen, M. (1995). Polycontextuality and boundary crossing in expert cognition: Learning and problem solving in complex work activities. *Learning and Instruction*, 5, 319–336.
- Engeström, Y., Engeström, R., & Kärkkäinen, M. (1997). The emerging horizontal dimension of practical intelligence: Polycontextuality and boundary crossing in complex work activities. In R. Sternberg & E. Grigorenko (Eds.), *Intelligence, heredity, and environment* (pp. 440–462). New York, NY: Cambridge University Press.
- Engeström, Y., Engeström, R., & Vähäaho, T. (1999). When the center does not hold: The importance of knotworking. In S. Chaiklin, M. Hedegaard, & U. J. Jensen (Eds.), *Activity theory and social practices* (pp. 12–30). Aarhus, Denmark: Aarhus University Press.
- Engeström, Y., & Sannino, A. (2010). Studies of expansive learning: Foundations, findings and future challenges. *Educational Research Review*, 5, 1–24.
- Falconer, I. (2007). Mediating between practitioner and developer communities: The learning activity design in education experience. *ALT-J: Research in Learning Technology*, 15, 155–170.
- Faraj, S., & Xiao, Y. (2006). Coordination in fast-response organizations. *Management Science*, 52, 1155–1169.
- Fenton, E. M. (2007). Visualising strategic change: The role and impact of process maps as boundary objects in reorganisation. *European Management Journal*, 25, 104–117.
- Fine, G. A. (2004). Adolescence as cultural toolkit: High school debate and the repertoires of childhood and adulthood. *Sociological Quarterly*, 45, 1–20.

- Finlay, I. (2008). Learning through boundary-crossing: Further education lecturers learning in both the university and workplace. *European Journal of Teacher Education*, 31(1), 73–87.
- Fisher, D., & Atkinson-Grosjean, J. (2002). Brokers on the boundary: Academy-industry liaison in Canadian universities. *Higher Education*, 44, 449–467.
- Fleischmann, K. R. (2003). Frog and cyberfrog are friends: Dissection simulation and animal advocacy. *Society & Animals*, 11, 123–143.
- Fleischmann, K. R. (2007). Digital libraries with embedded values: Combining insights from LIS and science and technology studies. *Library Quarterly*, 77, 409–427.
- Fortuin, I. K. P. J., & Bush, S. R. (2010). Educating students to cross boundaries between disciplines and cultures and between theory and practice. *International Journal of Sustainability in Higher Education*, 11(1), 19–35.
- Fuller, A., Kakavelakis, K., Felstead, A., Jewson, N., & Unwin, L. (2009). Learning, knowing and controlling the stock: The nature of employee discretion in a supermarket chain. *Journal of Education and Work*, 22, 105–120.
- Gal, U. (2008). *Boundary matters: The dynamics of boundary objects, information infrastructures, and organisational identities* (Unpublished doctoral dissertation). Case Western Reserve University, Cleveland, OH.
- Garcia, M., & McDowell, T. (2010). Mapping social capital: A critical contextual approach for working with low-status families. *Journal of Marital and Family Therapy*, 36(1), 96–107.
- Garraway, J. (2010). Knowledge boundaries and boundary-crossing in the design of work-responsive university curricula. *Teaching in Higher Education*, 15, 211–222.
- Gasson, S. (2005). The dynamics of sensemaking, knowledge, and expertise in collaborative, boundary-spanning design. *Journal of Computer-Mediated Communication*, 10(4), Article 14. doi:10.1111/j.1083-6101.2005.tb00277.x
- Geiger, S., & Finch, J. (2009). Industrial sales people as market actors. *Industrial Marketing Management*, 38, 608–617.
- George, J. (1999). World view analysis of knowledge in a rural village: Implications for science education. *Science Education*, 83, 77–95.
- Gergen, K. (1994). *Realities and relationships: Soundings in social construction*. Cambridge, MA: Harvard University Press.
- Goodwin, C. (Ed.). (2005). *Seeing in depth*. Mahwah, NJ: Erlbaum.
- Gorodetsky, M., & Barak, J. (2008). The educational-cultural edge: A participative learning environment for co-emergence of personal and institutional growth. *Teaching and Teacher Education*, 24, 1907–1918.
- Gorodetsky, M., & Barak, J. (2009). Back to schooling: Challenging implicit routines and change. *Professional Development in Education*, 35, 585–600.
- Guile, D., & Griffiths, T. (2001). Learning through work experience. *Journal of Education and Work*, 14, 113–131.
- Gutiérrez, K. D. (2008). Developing a sociocritical literacy in the third space. *Reading Research Quarterly*, 43, 148–164.
- Gutiérrez, K., Rymes, B., & Larson, J. (1995). Script, counterscript, and underlife in the classroom: James Brown versus Brown v. Board of education. *Harvard Educational Review*, 65, 445–471.
- Hall, R., Stevens, R., & Torralba, T. (2002). Disrupting representational infrastructure in conversations across disciplines. *Mind, Culture, and Activity*, 9, 179–210.
- Hall, R., Stevens, R., & Torralba, T. (2005). Disrupting representational infrastructure in conversations across disciplines. In S. J. Derry, C. D. Schunn, & M. A. Gernsbacher

- (Eds.), *Interdisciplinary collaboration: An emerging cognitive science* (pp. 123–166). Mahwah, NJ: Erlbaum.
- Harreveld, B., & Singh, M. (2009). Contextualising learning at the education-training-work interface. *Education and Training, 51*, 92–107.
- Harris, R., & Simons, M. (2006). VET practitioners working with private enterprises: A “third space”? *Journal of Workplace Learning, 18*, 478–494.
- Hasu, M., & Engeström, Y. (2000). Measurement in action: An activity-theoretical perspective on producer-user interaction. *International Journal of Human-Computer Studies, 53*, 61–89.
- Heldal, F. (2010). Multidisciplinary collaboration as a loosely coupled system: Integrating and blocking professional boundaries with objects. *Journal of Interprofessional Care, 24*(1), 19–30.
- Hemetsberger, A., & Reinhardt, C. (2009). Collective development in open-source communities: An activity theoretical perspective on successful online collaboration. *Organization Studies, 30*, 987–1008.
- Hepso, V. (2008). “Boundary-spanning” practices and paradoxes related to trust among people and machines in a high-tech oil and gas environment. In D. Jemielniak & J. Kociatkiewicz (Eds.), *Management practices in high tech environments* (pp. 1–17). Hershey, PA: Information Science Reference/IGI Global.
- Heracleous, L. (2004). Boundaries in the study of organization. *Human Relations, 57*, 95–103.
- Hermans, H. J. M., & Hermans-Konopka, A. (2010). *Dialogical self theory: Positioning and counter-positioning in a globalizing society*. Cambridge, UK: Cambridge University Press.
- Hermans, H. J. M., & Kempen, H. J. G. (1993). *The dialogical self: Meaning as movement*. San Diego, CA: Academic Press.
- Hildreth, P., Kimble, C., & Wright, P. (2000). Communities of practice in the distributed international environment. *Journal of Knowledge Management, 4*(1), 27–38.
- Hinds, P., & Kiesler, S. (1995). Communication across boundaries: Work, structure, and use of communication technologies in a large organization. *Organization Science, 6*, 373–393.
- Hong, J. F., & O, F. K. (2009). Conflicting identities and power between communities of practice: The case of IT outsourcing. *Management Learning, 40*, 311–326.
- Hoyles, C., Bakker, A., Kent, P., & Noss, R. (2007). Attributing meanings to representations of data: The case of statistical process control. *Mathematical Thinking and Learning, 9*, 331–360.
- Hoyles, C., Noss, R., & Kent, P. (2004). On the integration of digital technologies into mathematics classrooms. *International Journal of Computers for Mathematical Learning, 9*, 309–326.
- Huemer, L., Becerra, M., & Lunan, R. (2004). Organizational identity and network identification: Relating within and beyond imaginary boundaries. *Scandinavian Journal of Management, 20*, 53–73.
- Hughes, M., & Greenhough, P. (2008). “We do it a different way at my school”: Mathematics homework as a site for tension and conflict. In A. Watson & P. Winbourne (Eds.), *New directions for situated cognition in mathematics education* (pp. 129–151). New York, NY: Springer.
- Hung, D., & Chen, D. T. V. (2007). Context–process authenticity in learning: Implications for identity enculturation and boundary crossing. *Educational Technology Research and Development, 55*, 147–167.

- Hunter, S. (2008). Living documents: A feminist psychosocial approach to the relational politics of policy documentation. *Critical Social Policy*, 28, 506–528.
- Hustad, E. (2007). Managing structural diversity: The case of boundary spanning networks. *Electronic Journal of Knowledge Management*, 5, 399–410.
- Huyard, C. (2009). How did uncommon disorders become “rare diseases”? History of a boundary object. *Sociology of Health & Illness*, 31, 463–477.
- Huzzard, T., Ahlberg, B. M., & Ekman, M. (2010). Constructing interorganizational collaboration: The action researcher as boundary subject. *Action Research*, 8, 293–314.
- Johannessen, L. K., & Ellingsen, G. (2009). Integration and generification-agile software development in the healthcare market. *Computer Supported Cooperative Work*, 18, 607–634.
- Jones, C. (2010). Finding a place in history: Symbolic and social networks in creative careers and collective memory. *Journal of Organizational Behavior*, 31, 726–748.
- Kärkkäinen, M. (2000). Teams as network builders: Analysing network contacts in Finnish elementary school teacher teams. *Scandinavian Journal of Educational Research*, 44, 371–391.
- Kellogg, K. C., Orlikowski, W. J., & Yates, J. (2006). Life in the trading zone: Structuring coordination across boundaries in postbureaucratic organizations. *Organization Science*, 17, 22–44.
- Kent, P., Noss, R., Guile, D., Hoyles, C., & Bakker, A. (2007). Characterizing the use of mathematical knowledge in boundary-crossing situations at work. *Mind, Culture, and Activity*, 14, 64–82.
- Kerosuo, H. (2001). Boundary encounters as place for learning and development at work. *Outlines: Critical Social Studies*, 3(1), 53–65.
- Kerosuo, H. (2004). Examining boundaries in health care—Outline of a method for studying organizational boundaries in interaction. *Outlines: Critical Social Studies*, 6(1), 35–60.
- Kerosuo, H., & Engeström, Y. (2003). Boundary crossing and learning in creation of new work practice. *Journal of Workplace Learning*, 15, 345–351.
- Kim, J., & King, J. (2004). Managing knowledge work: Specialization and collaboration of engineering problem-solving. *Journal of Knowledge Management*, 8(2), 53–63.
- Kisiel, J. F. (2010). Exploring a school-aquarium collaboration: An intersection of communities of practice. *Science Education*, 94, 95–121.
- Konkola, R., Tuomi-Gröhn, T., Lambert, P., & Ludvigsen, S. (2007). Promoting learning and transfer between school and workplace. *Journal of Education and Work*, 20, 211–228.
- Kynigos, C., & Psycharis, G. (2009). Investigating the role of context in experimental research involving the use of digital media for the learning of mathematics: Boundary objects as vehicles for integration. *International Journal of Computers for Mathematical Learning*, 14, 265–298.
- Lagesen, V. A. (2010). The importance of boundary objects in transcultural interviewing. *European Journal of Women's Studies*, 17, 125–142.
- Lamont, M., & Molnár, V. (2002). The study of boundaries in the social sciences. *Annual Review of Sociology*, 28, 167–195.
- Landa, M. S. H. (2008). *Crossing the divide: A phenomenological study of early childhood literacy teachers who choose to work with children in high-poverty schools* (Unpublished doctoral dissertation). University of Maryland, College Park.

- Landry, S. J., Levin, K., Rowe, D., & Nickelson, M. (2010). Enabling collaborative work across different communities of practice through boundary objects: Field studies in air traffic management. *International Journal of Human-Computer Interaction*, 26, 75–93.
- Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge, UK: Cambridge University Press.
- Leander, K. M. (2002). Polycontextual construction zones: Mapping the expansion of schooled space and identity. *Mind, Culture, and Activity*, 9, 211–237.
- Lee, C. P. (2007). Boundary negotiating artifacts: Unbinding the routine of boundary objects and embracing chaos in collaborative work. *Computer Supported Cooperative Work*, 16, 307–339.
- Lee, H. J. (2009). *The screen as boundary object in the realm of imagination* (Doctoral dissertation). Retrieved from Dissertation Abstracts database. (2009-99231-317)
- Levina, N., & Orlikowski, W. J. (2009). Understanding shifting power relations within and across organizations: A critical genre analysis. *Academy of Management Journal*, 52, 672–703.
- Liebenberg, L. (2009). The visual image as discussion point: Increasing validity in boundary crossing research. *Qualitative Research*, 9, 441–467.
- Lindgren, M., & Wåhlin, N. (2001). Identity construction among boundary-crossing individuals. *Scandinavian Journal of Management*, 17, 357–377.
- Lotman, Y. M. (1990). *Universe of the mind. A semiotic theory of culture* (A. Shukman, Trans.). Bloomington: Indiana University Press.
- Loveman, M., & Muniz, J. O. (2007). How Puerto Rico became White: Boundary dynamics and intercensus racial reclassification. *American Sociological Review*, 72, 915–939.
- Ludvigsen, S. R., Lund, A., Rasmussen, I., & Säljö, R. (Eds.). (2010). *Introduction. Learning across sites. New tools, infrastructures and practices*. London, UK: Routledge.
- Luna-Reyes, L. F., Black, L. J., Cresswell, A. M., & Pardo, T. A. (2008). Knowledge sharing and trust in collaborative requirements analysis. *System Dynamics Review*, 24, 265–297.
- Lund, A. (2006). The multiple contexts of online language teaching. *Language Teaching Research*, 10, 181–204.
- Lutters, W. G., & Ackerman, M. S. (2007). Beyond boundary objects: Collaborative reuse in aircraft technical support. *Computer Supported Cooperative Work*, 16, 341–372.
- Macpherson, A., & Jones, O. (2008). Object-mediated learning and strategic renewal in a mature organization. *Management Learning*, 39, 177–201.
- Marková, I. (2003). *Dialogicality and social representations: The dynamics of mind*. Cambridge, UK: Cambridge University Press.
- Marková, I. (2006). On the “inner alter” in dialogue. *International Journal for Dialogical Science*, 1(1), 125–147.
- Massanari, A. L. (2010). Designing for imaginary friends: Information architecture, personas and the politics of user-centered design. *New Media & Society*, 12, 401–416.
- Matusov, E., Smith, M., Candela, M. A., & Lilu, K. (2007). “Culture has no internal territory”: Culture as dialogue. In J. Valsiner & A. Rosa (Eds.), *The Cambridge handbook of sociocultural psychology* (pp. 460–483). New York, NY: Cambridge University Press.

- Melles, G. (2008). Curriculum documents and practice in the NZ polytechnic sector: Consensus and dissensus. *Research in Post-Compulsory Education*, 13(1), 55–67.
- Metiu, A. M. (2002). *Faraway, so close: Code ownership over innovative work in the global software industry* (Unpublished doctoral dissertation). University of Pennsylvania, Philadelphia.
- Miettinen, R. (2006). The sources of novelty: A cultural and systemic view of distributed creativity. *Creativity and Innovation Management*, 15, 173–181.
- Mitchell, R., Parker, V., Giles, M., & White, N. (2010). Toward realizing the potential of diversity in composition of interprofessional health care teams: An examination of the cognitive and psychosocial dynamics of interprofessional collaboration. *Medical Care Research and Review*, 67(1), 3–26.
- Mørk, B. E., Aanestad, M., Hanseth, O., & Grisot, M. (2008). Conflicting epistemic cultures and obstacles for learning across communities of practice. *Knowledge & Process Management*, 15(1), 12–23.
- Morse, R. S. (2010a). Bill Gibson and the art of leading across boundaries. *Public Administration Review*, 70, 434–442.
- Morse, R. S. (2010b). Integrative public leadership: Catalyzing collaboration to create public value. *Leadership Quarterly*, 21, 231–245.
- Neff, G., Fiore-Silfvast, B., & Dossick, C. S. (2010). A case study of the failure of digital communication to cross knowledge boundaries in virtual construction. *Information, Communication & Society*, 13, 556–573.
- Nitzgen, D. (2004). Commentary on “boundary objects and group analysis” by Erica Burman. *Group Analysis*, 37, 379–385.
- Nosek, J. T. (2004). Group cognition as a basis for supporting group knowledge creation and sharing. *Journal of Knowledge Management*, 8(4), 54–64.
- O’Mahony, S., & Bechky, B. A. (2008). Boundary organizations: Enabling collaboration among unexpected allies. *Administrative Science Quarterly*, 53, 422–459.
- Ordanini, A., Rubera, G., & Sala, M. (2008). Integrating functional knowledge and embedding learning in new product launches: How project forms helped EMI music. *Long Range Planning: International Journal of Strategic Management*, 41(1), 17–32.
- Oswick, C., & Robertson, M. (2009). Boundary objects reconsidered: From bridges and anchors to barricades and mazes. *Journal of Change Management*, 9, 179–194.
- Paay, J., Sterling, L., Vetere, F., Howard, S., & Boettcher, A. (2009). Engineering the social: The role of shared artifacts. *International Journal of Human-Computer Studies*, 67, 437–454.
- Palmer, C. L. (1999). Structures and strategies of interdisciplinary science. *Journal of the American Society for Information Science*, 50, 242–253.
- Paterson, G. I. (2007). *Boundary infrastructures for chronic disease* (Unpublished doctoral dissertation). Dalhousie University, Halifax, Canada.
- Paulsen, N., & Hernes, T. (Eds.). (2003). *Managing boundaries in organizations: Multiple perspectives*. London, UK: Palgrave Macmillan.
- Pennington, D. D. (2010). The dynamics of material artifacts in collaborative research teams. *Computer Supported Cooperative Work*, 19, 175–199.
- Phelan, P., Davidson, A. L., & Cao, H. T. (1991). Students’ multiple worlds: Negotiating the boundaries of family, peer, and school cultures. *Anthropology and Education Quarterly*, 22, 224–250.
- Pierce, S. J. (1999). Boundary crossing in research literatures as a means of interdisciplinary information transfer. *Journal of the American Society for Information Science*, 50, 271–279.

- Pohl, C., van Kerkhoff, L., Hirsch Hadorn, G., & Bammer, G. (2008). Integration. In G. Hirsch Hadorn, H. Hoffmann-Riem, S. Biber-Klemm, W. Grossenbacher-Mansuy, D. Joye, C. Pohl, U. Wiesmann, & E. Zemp (Eds.), *Handbook of transdisciplinary research* (pp. 411–424). New York, NY: Springer.
- Postlethwaite, K. (2007). Boundary crossings in research: Towards a cultural understanding of the research project “transforming learning cultures in further education.” *Educational Review*, 59, 483–499.
- Puustinen, M., Baker, M., & Lund, K. (2006). GESTALT: A framework for redesign of educational software. *Journal of Computer Assisted Learning*, 22, 34–46.
- Rasku-Puttonen, H., Etelapelto, A., Lehtonen, O., Nummila, L., & Hakkinen, P. (2004). Developing teachers’ professional expertise through collaboration in an innovative ICT-based learning environment. *European Journal of Teacher Education*, 27(1), 47–60.
- Rose-Anderssen, C., Baldwin, J., & Ridgway, K. (2010). Communicative interaction as an instrument for integration and coordination in an aerospace supply chain. *Journal of Management Development*, 29, 193–209.
- Roth, W., & Lee, Y. (2007). “Vygotsky’s neglected legacy”: Cultural-historical activity theory. *Review of Educational Research*, 77, 186–232.
- Roth, W., & McGinn, M. K. (1998). >unDELETE science education: /Lives/work/voices. *Journal of Research in Science Teaching*, 35, 399–421.
- Säljö, R. (2003). Epilogue: From transfer to boundary-crossing. In T. Tuomi-Gröhn & Y. Engeström (Eds.), *Between school and work: New perspectives on transfer and boundary-crossing* (pp. 311–321). Amsterdam, Netherlands: Pergamon.
- Saunders, M. (2006). From “organisms” to “boundaries”: The uneven development of theory narratives in education, learning and work connections. *Journal of Education and Work*, 19, 1–27.
- Scarborough, H., Swan, J., Laurent, S., Bresnen, M., Edelman, L., & Newell, S. (2004). Project-based learning and the role of learning boundaries. *Organization Studies*, 25, 1579–1600.
- Schryer, C. F., Afros, E., Mian, M., Spafford, M., & Lingard, L. (2009). The trial of the expert witness: Negotiating credibility in child abuse correspondence. *Written Communication*, 26, 215–246.
- Scott, S. V., & Walsham, G. (2005). Reconceptualizing and managing reputation risk in the knowledge economy: Toward reputable action. *Organization Science*, 16, 308–322.
- Shumate, M., & Fulk, J. (2004). Boundaries and role conflict when work and family are collocated: A communication network and symbolic interaction approach. *Human Relations*, 57, 55–74.
- Smeby, J., & Vågan, A. (2008). Recontextualising professional knowledge. Newly qualified nurses and physicians. *Journal of Education and Work*, 21, 159–173.
- Soja, E. (1996). *Thirdspace: Journeys to Los Angeles and other real-and-imagined places*. Oxford, UK: Blackwell.
- Soliday, M. (1995). Shifting roles in classroom tutoring: Cultivating the art of boundary crossing. *Writing Center Journal*, 16(1), 59–73.
- Star, S. L. (1989). The structure of ill-structured solutions: Boundary objects and heterogeneous distributed problem solving. In L. Gasser & M. Huhns (Eds.), *Distributed artificial intelligence* (pp. 37–54). San Mateo, CA: Morgan Kaufmann.
- Star, S. L. (2005). Categories and cognition: Material and conceptual aspects of large-scale category systems. In S. J. Derry, C. D. Schunn, & M. A. Gernsbacher (Eds.),

- Interdisciplinary collaboration: An emerging cognitive science* (pp. 167–186). Mahwah, NJ: Erlbaum.
- Star, S. L. (2010). This is not a boundary object: Reflections on the origin of a concept. *Science, Technology, & Human Values*, 35, 601–617.
- Star, S. L., & Griesemer, J. R. (1989). Institutional ecology, “translations” and boundary objects: Amateurs and professionals in Berkeley’s Museum of Vertebrate Zoology, 1907–39. *Social Studies of Science*, 19, 387–420.
- Stein, M. K., & Coburn, C. E. (2008). Architectures for learning: A comparative analysis of two urban school districts. *American Journal of Education*, 114, 583–626.
- Strübing, J. (1998). Bridging the gap: On the collaboration between symbolic interactionism and distributed artificial intelligence in the field of multi-agent systems research. *Symbolic Interaction*, 21, 441–463.
- Suchman, L. (1994). Working relations of technology production and use. *Computer Supported Cooperative Work*, 2, 21–39.
- Swan, J., Bresnen, M., Newell, S., & Robertson, M. (2007). The object of knowledge: The role of objects in biomedical innovation. *Human Relations*, 60, 1808–1837.
- Swan, J., Scarbrough, H., & Robertson, M. (2002). The construction of “communities of practice” in the management of innovation. *Management Learning*, 33, 477–496.
- Tanggaard, L. (2007). Learning at trade vocational school and learning at work: Boundary crossing in apprentices’ everyday life. *Journal of Education and Work*, 20, 453–466.
- Tate, W. F. I. V. (2008). From the desk of the president: Building a stimulating and sustainable research enterprise. *Educational Researcher*, 37(1), 51–52.
- Telles, E. E., & Sue, C. A. (2009). Race mixture: Boundary crossing in comparative perspective. *Annual Review of Sociology*, 35, 129–146.
- Thurk, J., & Fine, G. A. (2003). The problem of tools: Technology and the sharing of knowledge. *Acta Sociologica*, 46(2), 107–117.
- Timmons, S., & Tanner, J. (2004). A disputed occupational boundary: Operating theatre nurses and operating department practitioners. *Sociology of Health & Illness*, 26, 645–666.
- Toiviainen, H., Kerosuo, H., & Syrjala, T. (2009). “Development radar”: The co-configuration of a tool in a learning network. *Journal of Workplace Learning*, 21, 509–524.
- Tsui, A. B. M., & Law, D. Y. K. (2007). Learning as boundary-crossing in school–university partnership. *Teaching and Teacher Education*, 23, 1289–1301.
- Tuomi-Gröhn, T., & Engeström, Y. (Eds.). (2003). *Between school and work: New perspectives on transfer and boundary-crossing*. Amsterdam, Netherlands: Pergamon.
- Tuomi-Gröhn, T., Engeström, Y., & Young, M. (2003). From transfer to boundary-crossing between school and work as a tool for developing vocational education: An introduction. In T. Tuomi-Gröhn & Y. Engeström (Eds.), *Between school and work: New perspectives on transfer and boundary-crossing* (pp. 1–18). Amsterdam, Netherlands: Pergamon.
- Turner, V. W. (1969). *The ritual process: Structure and anti-structure*. Chicago, IL: PAJ.
- Vähäsantanen, K., Saarinen, J., & Eteläpelto, A. (2009). Between school and working life: Vocational teachers’ agency in boundary-crossing settings. *International Journal of Educational Research*, 48, 395–404.
- Valsiner, J. (2007). Looking across cultural boundaries. *Integrative Psychological and Behavioral Science*, 41, 219–224.

- van Eijck, M., Hsu, P., & Roth, W. (2009). Translations of scientific practice to “students’ images of science.” *Science Education*, 93, 611–634.
- Van Gennep, A. (1960). *The rites of passage*. London, UK: Routledge Kegan Paul. (Original work published 1909)
- Veinot, T. C. (2007). “The eyes of the power company”: Workplace information practices of a vault inspector. *Library Quarterly*, 77, 157–179.
- Venkat, H., & Adler, J. (2008). Expanding the foci of activity theory: Accessing the broader contexts and experiences of mathematics education reform. *Educational Review*, 60, 127–140.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.
- Vygotsky, L. S. (1986). *Thought and language* (A. Kozulin, Ed., Trans.). Cambridge, MA: MIT Press. (Original work published 1934)
- Walker, D., & Nocon, H. (2007). Boundary-crossing competence: Theoretical considerations and educational design. *Mind, Culture, and Activity*, 14, 178–195.
- Walker, S., & Creanor, L. (2005). Crossing complex boundaries: Transnational online education in European trade unions. *Journal of Computer Assisted Learning*, 21, 343–354.
- Wenger, E. (1998). *Communities of practice, learning, meaning and identity*. Cambridge, UK: Cambridge University Press.
- Werr, A., Blomberg, J., & Lowstedt, J. (2009). Gaining external knowledge—boundaries in managers’ knowledge relations. *Journal of Knowledge Management*, 13(6), 448–463.
- Wertsch, J. V., & Toma, C. (1995). Discourse and learning in the classroom: A socio-cultural approach. In L. P. Steffe & J. Gale (Eds.), *Constructivism in education* (pp. 159–175). Hillsdale, NJ: Erlbaum.
- White, M., Härtel, C. E. J., & Panipucci, D. (2005). Understanding cross-cultural negotiation: A model integrating affective events theory and communication accommodation theory. In N. M. Ashkanasy, C. E. J. Hartel, & W. J. Zerbe (Eds.), *Emotions in organizational behavior* (pp. 167–182). Mahwah, NJ: Erlbaum.
- Whyte, J., Ewenstein, B., Hales, M., & Tidd, J. (2008). Visualizing knowledge in project-based work. *Long Range Planning: International Journal of Strategic Management*, 41(1), 74–92.
- Williams, J., Corbin, B., & McNamara, O. (2007). Finding inquiry in discourses of audit and reform in primary schools. *International Journal of Educational Research*, 46, 57–67.
- Williams, J., & Wake, G. (2007). Black boxes in workplace mathematics. *Educational Studies in Mathematics*, 64, 317–343.
- Yakura, E. K. (2002). Charting time: Timelines as temporal boundary objects. *Academy of Management Journal*, 45, 956–970.
- Yamazumi, K. (2006). Activity theory and the transformation of pedagogic practice. *Educational Studies in Japan: International Yearbook*, 1(7), 77–90.
- Yamazumi, K. (2009). Expansive agency in multi-activity collaboration. In A. Sannino, H. Daniels, & K. D. Gutierrez (Eds.), *Learning and expanding with activity theory* (pp. 212–227). New York, NY: Cambridge University Press.
- Yoo, Y., & Kanawattanachai, P. (2001). Developments of transactive memory systems and collective mind in virtual teams. *International Journal of Organizational Analysis*, 9, 187–208.
- Yoon, S., Pedretti, E., Bencze, L., Hewitt, J., Perris, K., & Van Oostveen, R. (2006). Exploring the use of cases and case methods in influencing elementary preservice

- science teachers' self-efficacy beliefs. *Journal of Science Teacher Education*, 17, 15–35.
- Young, M., & Muller, J. (2010). Three educational scenarios for the future: Lessons from the sociology of knowledge. *European Journal of Education*, 45(1), 11–27.
- Zitter, I., Kinkhorst, G., Simons, P. R. J., & ten Cate, O. (2009). In search of common ground: A task conceptualization to facilitate the design of (e)learning environments with design patterns. *Computers in Human Behavior*, 25, 999–1009.
- Zittoun, T., Gillespie, A., & Cornish, F. (2009). Fragmentation or differentiation: Questioning the crisis in psychology. *Integrative Psychological and Behavioral Science*, 43, 104–115.

Authors

- SANNE F. AKKERMAN has worked on this review study at the Freudenthal Institute for Science and Mathematics Education and is currently working as associate professor at the Department of Education of Utrecht University, Heidelberglaan 8, 3584 CS, Utrecht, The Netherlands; e-mail: s.f.akkerman@uu.nl. For the last ten years she has been studying processes of boundary crossing and learning in various contexts, including interorganizational collaboration, intercultural communication, group diversity, school–work transitions, interdisciplinary science, and also considering at individual level the dialogical identity of students and professionals acting as brokers.
- ARTHUR BAKKER is an assistant professor at the Freudenthal Institute for Science and Mathematics Education, Utrecht University, Princetonplein 5, 3584 CC, Utrecht, Netherlands; e-mail: a.bakker4@uu.nl. For several years he has been studying the development of techno-mathematical literacies in various workplaces and more recently has focused on vocational education and school–work transitions in particular. In his research he draws on sociocultural and cultural historical activity theories.