

Recursive approaches to technology adoption, families, and the life course: actor-network theory and strong-structuration theory

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Introduction

While numerous models are used to explain technology adoption (such as the widely used ‘Technology Acceptance Model’ and its several variants), we still await a comprehensive framework that integrates technological materiality, the situation of its implementation, and users’ expectations and experiences. The absence is especially glaring when we consider technology domestication in the sphere of the family and adoption across the life course (Dourish, 2004; Chuttur, 2009; Neves et al, 2017a; Neves et al, 2017b). This chapter seeks to address this absence by considering two ‘recursive’ approaches, which examine the reciprocal relationship between social structure and agency in the context of technology use over time. The recursive approaches under consideration are particularly useful given their integrative and situational sensitivity, focusing as they do on the intersection of users, contexts, and technologies (Greenhalgh and Stones, 2010). Here, we consider two approaches, adapted to the domain of digital technology: Actor-Network Theory (ANT) and Strong Structuration Theory (SST).

ANT has emerged under the ‘Social Shaping Theories’ approach, within Science and Technology Studies, as a response to technological determinism (MacKenzie and Wajcman, 1999). Technological determinism posits that technology is the cause of social change and that its development occurs independently of social, economic, cultural, and political forces, that is, ‘outside of society’ (MacKenzie and Wajcman, 1999; Wyatt, 2008). For instance, to define a civilization by its dominant technological artifacts (stone, iron, cars, microelectronics, etc.) is to treat technology as independent of societal forces except insofar as it generates them (Wyatt, 2008). ANT draws on this critique but goes further by rejecting any form of determinism, whether technological or social (particularly those studies undertaken from a ‘social construction of technology’ perspective). The focus of ANT is on the tracing of associations between entities—whether these entities are human or non-human. The ‘symmetrical’ approach that Actor-Network Theorists adopt entails the avoidance of any such discrimination. Hence, it informs a non-dualist account of technology and society that avoids essentialized notions of ‘the social’ or technology. Our second approach, SST, begins in a formal sociological inquiry into recurrent patterns or structures and the place of agency therein. The rise of ANT compelled Strong Structuration Theorists to consider the role of technology among the relations between agency and social structure. Despite following ANT in paying serious attention to the materiality of technology, it does not pursue it in postulating any ‘symmetry’ between people and technology. They remain assured that these ‘actants’ effect change differently and should therefore be studied differently (Greenhalgh and Stones, 2010). By combining structure, agency, and context, SST allows for a comprehensive analysis of users, technologies, and their situational dimensions.

In this chapter, we outline each approach, describing the theoretical commitments it entails for the researcher. Following an initial outline, we sketch the ways in which these approaches have been, and can be, applied in the domains of family and life course studies. Finally, we consider the opportunities and challenges that these approaches bring with them for the empirical study of technology adoption in these domains. To our knowledge this is the first attempt to discuss these recursive approaches as theoretical and analytical models to frame the relationship between technology use, family life, and life course dynamics. Due to their comprehensive nature in studying society and technology, ANT and SST are useful theoretical resources for family and life course researchers.

Recursive Approaches

Actor-Network Theory (ANT)

Located beyond both social and technological determinism, and rejecting any dualism between society and technology, is Actor-Network Theory (ANT) (Latour, 1992). It takes its point of departure in a resolutely “relational” approach (Law, 1999, p 4): what is important is not any one entity, whether human or non-human, social group or technological artefact, but the relations in which they are enmeshed. Crucially, the sociologist deploying this “symmetrical” approach is discouraged from discriminating among the *kinds* of relations and entities that together comprise a network. Whether the points of the network relate on the basis of political or familial relations, cellular relations, or technological relations, should not concern the sociologist. Actor-network theorists often begin by noting that the social and the technological are “inextricably” bound and

inseparable (Law and Callon, 1988, p 285). Technology and society do not merely constitute one another (as a weak constructionism would have it). Rather, a stronger claim is being made: society *is* technological, just as technology is social. No line between the technological and the social can be drawn in a consistent and confident fashion, because technological apparatuses are inextricably entangled in, and so constitutive of, social relations. Networks are thus irreducibly “hybrid” in character, comprised of elements that only appear separate in retrospect, after they have been “purified” and separated out into technological elements, on the one hand, and social elements, on the other (Latour, 1993, p 78). Latour (1990, p 129) notes that “[s]ociety and technology are not two ontologically distinct entities but more like phases of the same essential action”. While technologies might be “inscribed” with certain interests and intended ends, their place within a network of heterogeneous actants imposes certain “translations” on their being. Conversely, their inscribed ends oblige other actants to adjust—including the users of the technology (Latour, 1992).

Considering technology itself as a kind of teacher, Latour (2014, p 209) asks what we can learn if we give up the pretension of presuming to know the nature and causal properties of an actor like technology before we even begin to study it. The solution is to bracket our ordinary preconception of what an actor is: “*any thing* that does modify a state of affairs by making a difference is an actor” (Latour, 2005, p 72). By resisting the temptation at the outset to separate human from non-human entities, or the social from the technological, we are able to trace differences or effects by *following* these actors, wherever they might lead us.

Perhaps the most audacious claim such authors make is the methodological one that non-human entities ought to be treated as having “agency”. This is to apply a “symmetrical” approach to humans and non-humans, making no wager at the outset on each of their respective abilities to

act. While many have taken this to be a statement lacking in usefulness or, at worst, an example of mere obscurantism (Bloor, 1999, p 97), there is another reading that can orient us in a productive direction—though it does neutralize ANT’s apparently radical character (see Gingras, 1995): the ostensible “agency” of things can be taken as a weaker statement of the *obstinacy* of the technological world. Rather than being socially-determined or constructed in a unilateral manner, the simple projection of human technical ingenuity, technology rebounds on its creators and confounds the will of its users, producing surprises and other unexpected effects.

Applications

ANT has been used in a wide range of fields of only general relevance to those studying technological use and adoption within the family. Its more specific pertinence belongs to the Sociology of Technology, and other fields from Organization Studies to Information Systems (Hanseth et al, 2004; Cresswell et al, 2010). In particular, ANT is seen as a valuable model for Information Systems (IS), a field which was in the early 2000s still grappling with the lack of a “theoretical understanding of [its] key object”: the technological artifact (Hanseth et al, 2004, p 117). Furthermore, researchers also became interested in “technology-in-practice”, that is, “the specific structure routinely enacted as we use the specific machine, technique, appliance, device, or gadget in recurrent ways in our everyday situated activities” (Orlikowski, 2000, p 408). By conceptualizing technology as sociotechnical networks (with human and technological components), ANT elucidates both the relationship between technology as an ‘artifact’ and as ‘practice’ and the process by which they shape each other (Hanseth et al, 2004). ANT has been

employed in a variety of topics from computerized baggage handling in airports (Mähring et al, 2004) to medical technologies (Prout, 1996; Cresswell et al, 2010).

To our knowledge there is still no sociological application of ANT to digital technology adoption and family dynamics. Nor does a study rigorously deploy ANT within a life course perspective. Nevertheless, by reflecting on empirical applications in proximate domains we can identify dimensions of relevance to our subject. We selected one case study for this discussion, as it relates to family life and domestic technologies: Silva (2000) examines the historical evolution of the British cooker (1920s–1990s), in the midst of upheavals of assumptions about the gender division of labor within the home. She does this from a primarily Actor-Network perspective, employing ANT instrumentally, as a lens (seeing technology as ‘doing’, following the ‘relational materiality’ and ‘performativity’ of ANT) to study the involvement of actants in the development and use of both the thermostat oven control (1920-30s) and the microwave oven (1980s-90s). However, acknowledging the limitations of ANT in accounting for gendered power and subjectivities, Silva also draws on feminist poststructuralist analysis to explore the link between those technologies and notions of women and families in everyday life practices over time.

Using ANT, Silva uncovers scripts (and different interpretations) of gender identity and family living by examining manuals that instruct the user to set up the cooker or microwave oven and guidelines concerning the cooking process of food and recipes. The thermostat oven control in the 1920s and 1930s was designed for the housewife, and for a particular type of housewife: the middle-class one who had no servants. This oven is presented as clever and independent, dismissing the cook in the cooking process. Contradicting this presentation, the instructions requested continuous checking, evaluation, and modification of the cooking process which

demanded improvised adaptations according to circumstantial variation in food, weight, and fuel. Despite this narrative, the cook – the housewife – was never invisible and could not be attending to ‘sewing’ or ‘gardening’ as suggested. Innovative as the technology was, the cooker remained attached to, and demanded, the conventional female role. This attachment was redoubled by an industry which assumed that housewives could not deal with more advanced methods. When the microwave oven appeared in the 1970s, it was introduced as a “saviour of the busy housewife” (Silva, 2000, p 619). As women entered the labour market and family lifestyles started to adapt, microwaves were developed to defrost and reheat pre-prepared food. In fact, because they were mostly used for that and not for cooking, changes occurred in the technology design, including simplification of buttons and instructions, and the implementation of sensors. As with the thermostat oven, the machine was not fully independent and demanded checking and evaluation of the cooking process as well as the cook’s tacit skills (for example, types of food that work best with the technology). While the microwave oven recognized a more heterogeneous conception of the cook (beyond gender patterns), from the busy professional to the exhausted parent, more advanced combination cooking was still thought of as a female affair (instructions to prepare and freeze food, so it could then be heated by children and men). Both technologies were embedded with notions of users and their performance. But the processes of technology and family life shaped the ovens as usage did not match the rigid script, and also reflected new patterns of care and gender boundaries.

Implications: opportunities and challenges

The opportunities and challenges that ANT presents to the study of technology adoption and use within the family are illustrated well by Silva's work mentioned above. Its first benefit can be seen in its disregard for setting the scale of analysis in advance, as sociologists often do when referring to the "micro", "meso", and "macro" levels. ANT, on the contrary, by advocating that we follow actors, attends to how the latter themselves produce these scales (Latour, 2005, p 186). In Silva's deployment of ANT, the family is not abstracted and counted as a "micro" structure enfolded within something larger, like a community or society, but is defined pragmatically, by the kinds of associations the family makes to its surrounding world: "Some families or households may at different times be micro or macro, depending on the social connections that can be traced from their stories" (Silva, 2010, p 22). Since no scale is set in advance, a flexible analytical frame enables Silva to make the important point that families are not isolated from the world "around" them, operating with "consensual internal dynamics", but are "intermeshed" in the world in surprising ways (p 32). So, an ANT perspective does not distinguish between relations within the household and those "outside" it. Technological artifacts are exemplary here: imported from outside, they have roles *within* the familial division of labor delegated to them. So, the cooker that Silva examines is both a foreign piece of technology and, at least ideally, a representative for the labor ordinarily undertaken by the housewife. Moreover, just as members of the intergenerational family negotiate their relations with one another in ways commonly studied by sociologists of the family, so too do technical artefacts impose demands, "inscribed" in them by their producers, irreducible to the desires of their users (demands that are, as Silva shows, at the root of difficulties for working-class and working wives). Taking this diachronic view, can we perhaps employ ANT to ask whether the particular "life cycle" of a technology corresponds to different human life stages?

In its attempt to *follow* actants, trying to avoid becoming “obsessed...by the gesture of ‘placing things in their wider context’” (Latour, 2005, p 186), ANT arguably loses the gains that other theoretical approaches possess precisely on account of their attention to context. Namely, in Silva’s (2000, p 613) work we see the need for recourse to other means, namely Joan Scott’s post-structuralist feminism, to produce a properly “gendered analysis”. Here, while the ANT approach enables us to understand how certain gendered expectations and relations become inscribed in a technological artifact at a given time, it does not address the particular manner of appropriation, which always varies somewhat from its inscription (Couldry, 2008). In particular, Silva argues that historical changes to gender dynamics mean that the technology itself lacks the potency that ANT accords it. The Actor-Network Theorist could respond by noting that historical changes simply require us to take account again of the reshuffled network and the new place of the technology therein. Yet this arguably returns us to a mere description or tracing of associations and their effects, and does not try to get us closer to *explaining* observable changes or the interactions between the technology and those who adopt it. In a similar vein, it is finally unclear whether, by emphasizing description and analysis at the expense of explanation (Latour, 1988, p 163), ANT functions as a theory that is itself able to offer and accumulate insights transposable from one domain to another, or whether it remains a generic method tailored to tracing associations in isolated cases (Gingras, 2013, p 114). Its efficacy and appeal depend, nevertheless, on precisely what one wishes to use it for.

Strong Structuration Theory (SST)

If the attention to context remains a challenge in using ANT, it constitutes the point of departure for our second recursive approach: Strong Structuration Theory (SST). Born out of Giddens's structuration theory, SST was developed to remedy what were perceived to be the main defects of structuration theory. Its focus "on issues of ontology at a high level of abstraction" ensured neglect of methodological and epistemological questions, hampering the ability of researchers to deploy it in empirical study (Stones, 2005, p 32). Giddens's overall aim was to reconcile subjectivist and objectivist points of view in sociological theory. Subjectivism here refers to an approach in which the subject or "human agent is treated as the prime center for social analysis" (Giddens, 1986, p 530), with causal supremacy over its objective, structural conditions. Objectivism implies the converse, in which objective structure makes a puppet or plaything of the agent. By considering them as two independent series, Giddens (1984) argued, the sociologist renders into a "dualism" what is in fact "duality of structure". An "objective" structure is not something "external" to individuals or interaction, but is implicated in both: "as memory traces, and as instantiated in social practices, it is in a sense more 'internal' than exterior to [individuals'] activities" (Giddens, 1984, p 25). The structure constitutes the very dispositions individuals deploy in interaction, where they either reproduce the conditions that encourage the structure to flourish or subvert this reproduction. Thus, in Giddens' phrase, structure is both the medium and the outcome of material practice. In a surprising parallel with ANT (see Johnston, 2001), Giddens sought to begin his analysis from the study of "micro" practices, or "situated activities" of actors, asserting such a context as the site where agency and structure intersect.

Notwithstanding this acknowledgement of situated activity, some have claimed that this is the precise domain where structuration theory lacks. For this reason, Stones (2005) resolved to elaborate SST, distinguishing itself from its predecessor by moving away from "the ontology-in-

general of ‘structures’ and ‘agents’” towards the “ontology-in-situ” of *particular* structures and agents (Greenhalgh and Stones, 2010, p 1288). For Stones, Giddens remains satisfied with detecting in particular cases the mere presence of entities that he generally postulates – rules, resources, structures, and outcomes – without doing the work of examining the relations between these general elements and the modifications that specific situations and empirical cases impose on them (Stones, 2005, p 38). To overcome this limitation, while refining the theory for empirical application, SST orients itself by taking Giddens’s abstract approach in the direction of “particular concrete and/or situated entities in the world with their particular qualities, relations, shapes, tone, texture, colour and so on” (p 76). The obligation to reconcile these two levels of analysis leads Stones to propose for SST a revision of Giddens’s “duality of structure”. For Stones (p 84), to properly conceptualize this situation in which structure is both the medium and the outcome of practice, a “quadripartite” model is necessary. First, a social structure is posited, something that pre-exists and survives individuals, and provides the conditions for their practice. Second, it is “internalized” in the form of a general worldview, on the one hand, and a specific “conjunctural” knowledge and skill for acting in a certain realm, on the other hand. Third, on the basis of these internalized resources, social agents are afforded the ability to act in immediate situations, either deliberately or routinely, and in response to circumstances for which they might not be adequately disposed. Fourth, agents’ action in these very situations results in outcomes that either reproduce or revise the social structure that served as an initial condition for their practice. Together, these elements of the model are labelled external structures, internal structures, active agency, and outcomes.

More recently, Stones (along with Greenhalgh) has sought to nourish SST with a technological modality (Greenhalgh and Stones, 2010). Recognizing “the material properties of

technology within interaction”, and the instantiation or “inscription” of social structures in technologies, they have assimilated a technological dimension to the second element of SST’s quadripartite structure (Greenhalgh and Stones, 2010, p 1290). Like human actors, ‘actants’ (human agents and forms of technology) now internalize social structure, in the form of general material properties and particular, functional relations to specific situations (Greenhalgh and Stones, 2010).

Applications

Adapted to technology studies, SST helps to examine technologies as they are used ‘in the wild’, combining social context, human agency, and technology. As a preliminary, we should note that Giddens’s own structuration theory (1984) has itself been applied within technology studies, particularly in Information Systems; yet because here technology is merely conceptualized as a structure that facilitated or restricted human actions, it led to a total disregard of technology and a materialization of structures (Hanseth et al, 2004). This is precisely the kind of approach that led to ANT’s emphasis on the materiality of technological actors. SST seeks to overcome these issues by considering the place of technology amongst processes involving external and internal structures, active agency, and outcomes.

SST has been particularly popular in the study of health technologies (Greenhalgh and Stones, 2010; Greenhalgh et al, 2016; Jeffries et al, 2017) and organizational information systems (Jack and Kholeif, 2008; Kabanda and Brown, 2017). Still, to our knowledge it has not been applied at the intersection of technology, family, and the life course. As such, as with ANT, we will focus here on a related case study to inspect and sketch possible relationships and opportunities for application. This case study refers to our own study of technology adoption and

use of a novel communication app (InTouch) among older adults (aged 65+), living in care homes in Canada. InTouch was developed with and for older adults who are frail, institutionalized, and concerned with or at risk of social isolation and loneliness. The accessible app (running on Android and iOS devices) allows users to send audio, video, picture, and pre-set text messages to relatives and friends, who can then reply back using their own devices and email accounts. As informed by our field studies, drawing on a participatory design process, the app is asynchronous (users showed a clear desire to control time of communication due to health impairments and living context) and based on large icons (to adapt to users with visual limitations) and a touchscreen interface (there is no typing, only swiping and tapping, as developed for people with motor and dexterity issues) (Baecker et al, 2014).

To test adoption and use of this app, as well as its potential to address issues of social isolation and loneliness, we conducted two- and three-month deployments of the technology in a long-term care facility and a multi-care retirement community in Toronto, Canada (Neves et al, 2015; Neves et al, 2017a; Neves et al, 2017b). These studies included 16 older adults (ages ranged from 74 to 95; $M = 83.9$; $SD = 5.5$; ten identified as female and six as male) and their study partners (relatives or friends). The research design was based on pre-, mid-, and post-deployment stages with semi-structured interviews, psychometric scales (social support and loneliness), usability and accessibility tests, log analysis, and field observations. By using SST, we were able to examine the interplay of users, contexts, and technology. Findings highlighted the complexity of technology adoption among frail and institutionalized older adults, uncovering a set of critical factors that can both facilitate or hinder adoption, namely: social (family support, living arrangements), attitudinal (learning dispositions), digital literacy (prior and current level of digital skills), physical (type of motor impairment), and usability factors (ease of use of the app

and tablet). More importantly, these factors were interrelated. For example, on one hand, participants that had family deeply involved in the project were able to overcome previous digital illiteracy and quickly adopt the app. On the other hand, we found different communication preferences, norms, and expectations for family and participants. Family preferred synchronous communication and video and picture messages, whilst our participants had a preference for asynchronous communication and audio and text messages. Additionally, reply times were an issue as grandchildren were expecting quicker responses and participants would often take more than a day to reply (Neves et al, 2017a; Neves et al, 2017b).

With the SST approach, we discovered that context is simultaneously a condition for and an outcome of adoption. Bringing together those adoption factors and our specific technology, we can see their relationship through SST's elements: external structures (conditions of action) encompassed social factors (family norms and expectations, living arrangements, cultural signifiers) and the pre-existing functions of the technology. Internal structures (knowledge and capabilities) included digital literacy, attitudes, physical conditions and personal-based usability of the technology. Agency encompassed different adoption and usage of InTouch and outcomes were mostly linked to social interaction and social connectedness. For 13 participants, InTouch increased their sense of social interaction (communication frequency and type) with family and friends. For six participants, those who had relatives living abroad or afar, their social connectedness – which is more than social interaction, it is meaningful social interaction – increased with InTouch. However, for two of our participants, the technology had the potential to make them more aware of their social isolation and loneliness as relatives and friends did not reply to their messages (Neves et al, 2015; Neves et al, 2017a; Neves et al, 2017b).

Implications: opportunities and challenges

Strong Structuration Theory provides opportunities for empirical work that are especially visible when we contrast it to Actor-Network Theory. Recall that the latter rejected making recourse to the “context” of a phenomenon as a way to explain it. For Actor-Network Theorists, such abstractions as society, group, or structure put forth as an explanation the very thing that first needed to be explained. We saw this philosophical attitude come up against the limits of empirical study in Silva’s case, as she was forced to turn to feminist theory to explain the changing relation over time between technological artifacts and their users. SST offers an explanation at this level, encouraging us to think of these relations within a dilated perspective that includes historical and social structures. Still, by recognizing its own tendency toward abstraction (inherited from Giddens’s theory), it also seeks to integrate microsociological insights. So, not only are abstract variables like “agency” and “structure” at play, but attention must also be paid to the various causal properties of many kinds of immediate situations and actors, including those of family dynamics and technological artifacts. By considering the four elements of the quadripartite model (internal and external structures, active agency, and outcomes), we can better flesh out the interplay of agency and structure in the context of family life. For our participants, maintaining a connection with family was the main motivator to adopt the InTouch app, but family preferences and expectations also deeply influenced their uptake and use.

Emphasizing the role of these artifacts in the “recursive” framework, Strong Structuration Theorists offer us a way to formally capture what Silva (1999, p 57) described as the

“technological nexus”. That is, the intersection of structures, technologies, and their immediate contexts of deployment:

[T]he technological component of social structures may be positively instantiated when people choose, using interpretive flexibility, to use the technology in a particular way both within and outside the intended scripts, and also negatively instantiated when they either actively refuse to use it or, importantly, are unable to use it either at all or in the ways they would like (Greenhalgh and Stones, 2010, p 1290).

Implicit here is a distinction between the ways in which humans and technologies act. By adopting an asymmetrical approach, SST does not treat its actors as nodes subsumed within a flat network, as in ANT, but as qualitatively distinct. While Actor-Network Theorists proclaim their networks to be comprised of “heterogeneous” entities, they ultimately distinguish actors from one another by their capacity to produce effects within a given network and not on account of any ontological differences between them. Since SST takes such differences seriously, asking how the agency of technologies differs from that of humans, it is perhaps even more “radical” than its counterpart. In particular, its use of phenomenology to attend to the relation between the immediate situation and an agent’s embodied dispositions brings us closer to understanding the peculiar, asymmetrical experience that humans have with objects, particularly in a life course perspective (Greenhalgh and Stones, 2010, p 1290).

This nevertheless requires some wager on the nature of things, committing Greenhalgh et al (2014, p 211) to declare at the outset that technology “can only ‘act’ in a limited way”. This ultimately means relinquishing the gains that come with ANT’s symmetrical skepticism. As

Michael (2017, p 87) puts it, with any such a priori sorting of entities, we potentially “miss out on the complexity of the actants and their hybridity”. Indeed, we risk returning to a humanistic version of the agent: reflective and deliberate in opposition to the built and technological environment.

Conclusion

In line with the pluralistic pragmatism of Abbott (2004, p 76), the relation between methods like ANT and SST should not be thought in terms of progress from one to the other, but of mutual elucidation of empirical realms that the other does not – and perhaps cannot – consider. ANT makes the important point that we should not begin by assuming that we can explain particular things by reference to abstractions, while SST offers an approach to situated empirical study that does not become trapped in the endless tracing of associations. These different approaches are difficult to reconcile in practice and so require assumptions at the outset on the part of the researcher about the nature of the things in question: do we assume a significant qualitative difference between humans and technological artifacts? What do we lose with such an assumption? What does the researcher sacrifice when she sides with Actor-Network Theorists and makes an assumption of symmetry?

While each, to some extent, exposes the blind-spots of the other, our two case studies have demonstrated that both have their own uses, depending to a great extent on the empirical material the researcher is facing. This is to say that even in the realm of technology, family relations, and the life course there is no single and sure approach. So, to adopt one theoretical approach means relinquishing certain gains that can only be obtained by adopting another

approach. The upshot of this observation is that the study of ICTs and family relations across the life course is particularly ripe for inquiry by a combination of approaches, such as those surveyed here. We have demonstrated that recursive approaches can be productive given the nature of this topic.

In Brief:

- Recursive approaches to sociological study are considered as means to address the absence of a comprehensive approach to technology adoption.
- Actor-Network Theory and Strong Structuration Theory are offered as exemplary approaches given the particular characteristics of the form of technology adoption in question.
- Actor-Network Theory is shown to be methodologically useful but, nevertheless committed to analytical description over synthetic explanation and unlikely to incorporate accounts of historical change into its micro tracing of associations.
- Strong Structuration Theory pays due attention to context but is forced to relinquish the gains that come from Actor-Network Theory's radical approach to agency.
- Two case studies are presented as a way of illustrating the opportunities and limitations afforded by these approaches.

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