Culture and Psychological Responses to Environmental Shocks

Cultural Ecology of Sidama Impulsivity and Niche Construction in Southwest Ethiopia

by Robert J. Quinlan, Samuel Jilo Dira, Mark Caudell, and Marsha B. Quinlan

Sidama people occupy a subsistence niche partitioned between traditional enset agropastoralism and transitional maize farming. Enset production is low risk and requires multiple years for cultivation and processing. Maize farming is high risk and high yield, requiring one growing season from planting to harvest. Contrasting enset and maize farming, we examine effects of crop loss and social shocks on Sidama impulsivity. We argue that impulsivity is a psychological process that is differentially activated by environmental shocks in the stable, traditional enset regime and unstable, transitional maize regime. Using a robust psychometric model derived from Barratt impulsiveness scale items, we demonstrate two dimensions of Sidama impulsivity: careful control (CC) and acts without thinking (AWT). Both dimensions are associated with environmental shocks, but the associations are moderated by social-ecological regimes. In the enset regime, effects of shocks on impulsivity are muted. However, increased impulsivity is significantly associated with shocks in the global market–dependent maize regime. Effects on CC were significant for social shocks but not crop loss, while AWT was associated with crop loss and social shocks. Results may indicate domain-specific aspects of impulsivity in response to environmental perturbation. Impulsivity may be adaptive in the context bidirectional predictive processing in active cultural niche construction.

Human thought is cultural (Bloch 2012; D'Andrade 1995; Sperber and Hirchfeld 2004; Strauss and Quinn 1997). Familiar and shared ways of thinking that worked for extended periods of time—often generations—give people reliable mental models for action: How shall I greet a person of equal status? What is the appropriate response to an insult? These mental models inform predictable outcomes inferred through regular interaction with people and environments in patterned practices (Roepstorff et al. 2010). But how do people react when favored habits and familiar actions result in unexpected or undesirable outcomes? Culture change is an intrapsychic phenomenon when old perceptions of normality are replaced by new ones. We wonder, what psychological processes facilitate culture change, and when are they activated? We draw on insights from social-ecological systems, niche construction, cognitive science, psychometrics, and cultural ecology to examine impulsivity among Sidama people occupying a fragmented subsistence niche at the intersection of traditional enset and transitional maize production.

Recent developments in Sidama subsistence provide a case study in culture change. Most Sidama are agropastoral farmers living in the highlands to Rift Valley lowlands in Southwest Ethiopia. People have grown enset (*Ensete ventricosum* [Welw.] Cheesman), a root and stem staple crop, in this region since prehistoric times (Brandt 1984, 1996). The Sidama are one of the two most enset-reliant societies of the enset complex (Brandt et al. 1997; Quinlan et al. 2014; see also Shack 1963). Meanwhile, maize (*Zea mays* subsp. *mays* L.) is newer to the Sidama Zone, recently expanding into Southwest Ethiopia (McCann 2001). Maize has advantages relevant to local cli-

Robert J. Quinlan is an Associate Professor in the Department of Anthropology at Washington State University (Pullman, Washington 99164, USA [rquinlan@wsu.edu]). **Samuel Jilo Dira** is a Doctoral Graduate in the Department of Anthropology at Washington State University (Pullman, Washington 99164, USA) and a Former Lecturer of Sociology and Anthropology in the Department of Behavioral Science at Hawassa University (Hawassa, Ethiopia). **Mark Caudell** is a Doctoral Graduate in the Department of Anthropology at Washington State University (Pullman, Washington 99164, USA) and a Postdoctoral Researcher at the Paul G. Allen School for Global Animal Health, Washington State University (Pullman, Washington 99164, USA). **Marsha B. Quinlan** is an Associate Professor in the Department of Anthropology at Washington State University (Pullman, Washington 99164, USA). This paper was submitted 10 XI 14, accepted 26 VII 15, and electronically published 24 VIII 16.

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mate change (UNCCD 2014; WMO 2013): maize grows better than enset in drier weather, matures faster than enset, and recovers quickly after crop loss (Quinlan et al. 2015). Still, enset remains central to Sidama culture and identity.

We are interested in the ways social-ecological systems and psychological processes shape—and are shaped by—present-day Sidama transformations. We contrast enset and maize farming regimes as the focus of our analysis. We argue that impulsiveness is a psychological process differentially activated in response to environmental shocks in the stable, traditional enset regime compared with the unstable, transitional maize regime. We use a robust psychometric model derived from Barratt impulsiveness scale (BIS) items (Morean et al. 2014) tailored for use in the Sidama Zone. We demonstrate that two dimensions of Sidama impulsivity (careful control [CC] and acts without thinking [AWT]) are associated with social shocks (death or serious illness in the family) and crop loss. Social-ecological regimes moderate the associations: in the traditional closed system—the low-risk, slow-recovery enset regime—the effect of crop loss on impulsivity was muted. In contrast, impulsivity increased in response to social shocks in both regimes, but the effect was enhanced in the transitional, cross-scale, high-risk, fast-recovery maize farming regime. Two impulsivity dimensions (CC and AWT) responded differently to crop loss and social shocks: effects on CC were significant for social shocks and marginally significant for crop loss, while AWT was associated with crop loss and social shocks. These results may indicate domain-specific aspects of impulsivity responding to environmental perturbation. Impulsivity may be adaptive in the context of active cultural niche construction (e.g., Kendal et al. 2011; Laland and Brown 2006; O'Brian and Laland 2012; Rowley-Conwy and Layton 2011).

Ethiopian agricultural traditions are ancient: domestication occurred about 4,700 years ago for plants and 4,000 years ago for livestock (Harrower et al. 2010; Hildebrand et al. 2010). The East African cattle complex (Herskovitz 1926) appears across the Horn of Africa and intersects with two main Ethiopian farming traditions. Crops coexist with the cattle complex in a continuum of agropastoralism with a major role in shaping African history and culture (Murdock 1959). In northern Ethiopia, plow cultures dominate. These descendants of ancient civilizations (Pankhurst 2001) farm cereals—primarily teff but also wheat, barley, maize, sorghum, and millet. In the south, hoe cultures are common, planting enset and root crops—potatoes, sweet potatoes, yams (Westphal and Westphal-Stevels 1975). Among Ethiopian hoe cultures, enset is "by far" the most important staple, widely distributed throughout the montane area of Southwest Ethiopia (Murdock 1959:42). Southern enset farming predates northern cereal domestication (Hildebrand et al. 2010). Sidama farmers thus have deep historic ethnobotanical knowledge about enset (Brandt et al. 1997; Hildebrand 2009). Maize farming (detailed below) is a relative newcomer to Ethiopia, especially in the south, where we examine transitions from enset to maize in social-ecological and psychological perspectives.

Culture, Predictive Perception, and Systemic Shocks

An earlier generation of anthropologists (Hallowell 1941; Wallace 1957*a*, 1957*b*) suggested that culture change is a psychological reorientation in response to perturbation: Wallace (1957*b*) described maze way reorganization as a process reconfiguring culture in response to catastrophic shocks. Radically transformed social, economic, and physical environments obliterate old habits and ways of thinking. The new normal, or revitalized models, offer an updated adaptive strategy, where old modes of living no longer meet expectations. Wallace uses a mazeway metaphor with two components: (1) the maze is the pattern of the world that maze runners must learn to survive and succeed; (2) the way is the psychological representation of the maze in the maze runner's mind. Severe shocks cause a radical change in the maze, requiring a rapid response from the maze runner, who undergoes mazeway reorganization to learn the new or deteriorated maze. We attempt to update this mid-level theory and bring contemporary analysis to bear on processes of culture change. Our approach shares similarities with cultural consonance theory in a broad ecological and cognitive context (e.g., Dressler 2012): when cultural consonance (the fit between cultural representations and lived experience) is weak, impulsivity intervenes to reorient action.

Current theory in cognitive sciences (Clark 2013) suggests to us that Wallace's "way" refers to top-down cognitive models constructed through bottom-up sensory experience. Here cultural perception involves a set of top-down models of expected environments (mazes or regimes) that are fit to bottom-up data coming from the regime in a "bidirectional action-oriented predictive process" (Clark 2013:5–6). A person's internal state is a kind of conversation between representations and sensory information interacting in a hierarchical structure to make sense of the world. By acting on the external world, people generate new information they can use to adjust higher level representations (Clark 2013). Repeated interactions with social, economic, and political aspects of the local environment result in patterned practice shaping attention and expected environments in bidirectional processes (Roepstorff et al. 2010). Patterned practice accounts for the simultaneously phenotypic and environmental aspects of culture that influence each other through reciprocal feedback (Flinn and Alexander 1982). This feedback suggests both niche construction (e.g., Laland and Brown 2006) and social-ecological systems models (e.g., Folke 2006; Folke et al. 2010; Oishi and Graham 2010; Walker et al. 2004). But here is the rub: culture—perceptual and environmental components—is comfortable, resilient, and conservative, and people often greet challenges to established habits with moral suspicion. Despite cultural inertia, there must be a point at which we ask, how much do we endure maladaptive habits before we abandon them? How do we abandon them? What psychological mechanisms help us respond adaptively to unfulfilling culture?

Sensory data come from local environments. The world side of patterned practices (the maze) has its own dynamics that

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are influenced by and shape human perception and agency (Davidson 2010; Oishi and Graham 2010; see also Kendal et al. 2011; Laland and Brown 2006). Social-ecological dynamics involve basins of attraction that sometimes behave like local equilibria and sometimes do not (Folke et al. 2010; Walker et al. 2004). For people, attraction is not merely a mathematical property of an ecological system but a thing they can feel, like gravity. Stability landscapes include multiple possible regimes, configurations, or basins of attraction with properties including stability, transformability, resilience, latitude, and so on; these properties determine thresholds between alternative regimes (Folke et al. 2010; Walker et al. 2004). Here, a social-ecological regime is a collection of variables that respond systematically to perturbations. In response to perturbations, social-ecological systems exhibit adaptive cycles with periods of expansion, reorganization, and transformation that respond to internal (local) and external (global) shocks (Folke 2006). An expansive r phase of the cycle may precede a conservative, stable K phase (Folke 2006; Walker et al. 2004). But human agency is a missing element in social-ecological systems analysis (Davidson 2010). We are interested in analysis that can bridge the divide: "Our presumption, then [is] not that values, attitudes and personality attributes [are] epiphenomena … but rather that they [are] part and parcel of the system itself" (Edgerton 1971:24).

When a shock is substantial, adaptive perception may vault thresholds between alternative configurations to facilitate mazeway reorganization. Locally tuned personality may reduce the attraction of regimes encoded in cultural models. In part, thought shaped by labile personality (even perceived pathological dimensions of personality) could drive people away from locally maladaptive culture toward new possibilities. If traditional cultural models do not work well, then one should stop thinking with them.

Impulsivity is an aspect of personality that may facilitate transition to new regimes by altering the balance of sensory input and cultural models. Impulsivity, among other things, is characterized by lack of premeditation, the tendency to act without thinking, delay discounting, and sensation seeking (Sharma et al. 2014; Stanford et al. 2009). We suggest a pathway whereby unstable environments result in psychological responses—including impulsiveness—as a means of generating adaptive action.

We conceive of impulsivity as a context-dependent state (Hamaker et al. 2007; Lewis 2001). We acknowledge that there may be developmental stability in impulsivity (Boyce and Ellis 2005; Pepper and Nettle 2013; see also Nettle and Bateson 2015). However, key features of human responses to environmental risk, though influenced by developmental canalization, show situational sensitivity statistically independent of early development (Placek and Quinlan 2012; Quinlan 2010). And impulsivity, specifically, shows context dependence in psychological experiments (Hinson et al. 2003; Sharma et al. 2014). Though the BIS, used here, was conceptualized for trait measurement, factors for self-control and motor impulsivity—including our CC and AWT items, respectively—show 1-month test-retest reliabilities (Spearman's ρ) of 0.67 for motor and 0.73 for self-control (Stanford et al. 2009:387). BIS motor and self-control scores account for about 45%–53% of variance in scores 1 month later. If we assume that none of the 1-month test-retest correlation is due to environmental continuity, there is still a large proportion of variance sensitive to context. We suggest that Western personality psychology's emphasis on individual stability (and endogenous influences) reflects Western, educated, industrial, rich, democratic (WEIRD) patterned practice (Henrich et al. 2010). We return to WEIRD and variation in self-constructs in the discussion.

If cultural models shape thought, then we expect psychological mechanisms for turning off thought to be activated when cultural models fail to provide desired (predicted) results. In this sense, culture is a set of mental representations of the world that provide "model goal states" and locally relevant prior probabilities for thinking about achieving a goal (Clark 2013:6). Hence, people deploy a probabilistic or predictive mind in planning action (Tousant 2009). "The flow of inference respects Bayesian principles that balance prior expectations against new sensory evidence" in "bidirectional" processing (Clark 2013:8). When new sensory evidence conflicts with culturally encoded prior expectations, then generating adaptive action becomes a problem requiring a solution. When expectations fail to fit incoming information, then a bidirectional predictive mind may activate impulsive behavior to generate new input to reorganize top-down perception to fit the new regime.

Impulsivity is associated with multiple risk-taking behaviors (Lejuez et al. 2005; Robbins and Bryan 2004; Sharma et al. 2014), suggesting its behavioral role in risky environments (Boyce and Ellis 2005; Chisholm 1999; Pepper and Nettle 2013). Experimental manipulation shows that cognitive noise—interfering with inferential processes—generates impulsive immediate action, resulting in significantly discounted delayed rewards (Hinson et al. 2003). In these experiments, cognitive noise may have effects similar to ecologically mismatched cultural models—experimentally manipulated cognitive load and mismatched cultural models are impediments to useful probabilistic inference for the task at hand. Impulsivity turns down higher-order predictive models that do not work (fail to predict bottom-up signals) and simultaneously turns up sensory input (like the gain stage in an amplifier) to arrive at new, better-fitting cultural representations. Impulsivity generates exploratory behavior that provides new sensory input to help derive new patterned practices. Our hypothesis is that impulsiveness is an adaptation to unstable or transitional environments, implying that once the transition is complete, new models provide reliable predictions for action, and impulsiveness is deactivated awaiting some future where the old/new representations no longer yield useful predictions.

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Sidama Subsistence Schema and Social-Ecological Configurations

The Sidama niche is partitioned into traditional enset and transitional maize farming (Quinlan et al. 2015). These two niches involve well-elaborated, easily expressed cognitive schema or cultural theories of agricultural production. Enset farming is a relatively stable closed system with deep roots in time (Quinlan et al. 2014): livestock provide fertilizer for enset and milk for humans, and enset provides fodder for cattle and starch for humans. Enset is drought resistant and has a relatively low risk of crop loss, though recovery times are long (Quinlan et al. 2015). Enset farmers are in the K (stable conservative) stage. Maize farming, recently introduced (ca. 1950), is unstable and exposed to global shocks: risk of crop loss is high, given sensitivity to seasonal variation in rainfall. Maize also requires commercial fertilizer for adequate production, which is subject to substantial global price fluctuations. However, maize farms show better engineering resilience (time to recovery [Pimm 1991]) than do enset farms. Maize farmers are in the r (or expansion) stage of the adaptive cycle (Quinlan et al. 2015).

Farming in Ethiopia is a high-risk endeavor. Nearly 40% of Sidama farmers report losing half or more of their food crops in recent years, and crop loss leads to large deficits in per capita caloric production (Quinlan et al. 2015). Other cash crops may offset food crop losses. Coffee and *chat* (a mild stimulant sometimes called *khat* in Kenya, Somalia, and Yemen) are present in a small proportion of Sidama farms, and almost no Sidama reported either as their primary crop. Less than 7% of our sample grew any coffee or chat. The low frequency of these cash crops does not allow us to adequately assess their effect on risk, though preliminary analyses indicated that cash crops effects varied locally and did not substantially alter the analyses presented below. Future work requires larger samples to identify emerging factors in Sidama vulnerability and resilience. We include controls for more common assets to assess effects on risk buffering.

Enset farming has a clear, time-tested cultural model of production and diet. Sidama people readily talk about this enset-livestock complex as a system, the parts of which they understand well. Enset ethnobiological classification is highly elaborated, indicating substantial time depth for the Sidama-enset relationship (Quinlan et al. 2014). Indeed, traditional Sidama *mine* (house/yard) and *gate* (gardens) comprise compounds structured around enset production. Above an elevation of 1,400 m with sufficient rainfall, the Sidama cultural theory of enset production works perfectly as described, and we have empirically verified multivariate production results. Enset and *waasa*, the processed food it provides, are cherished commodities. But Sidama report a decline in the predictability and amount of rainfall since the mid-1970s. Enset does not provide adequate caloric returns in some areas where it once thrived (Quinlan et al. 2015).

Maize farming expanded and matured in Southwest Ethiopia recently from 1950 to 1975 (McCann 2001). In areas where a significant proportion of smallholders now grow maize, Sidama note that their parents hardly knew of it. In other Sidama districts, maize replaced enset as the primary crop (Quinlan et al. 2015). Traditionally, maize is a less preferred food to enset, and Sidama express little attachment to or identity drawn from maize production. In some areas, however, maize is gaining appeal as the preferred food, especially among younger people. A cultural schema or theory of maize production is evident and includes use of chemical fertilizer that is very sensitive to price fluctuations and global shocks distant from the everyday life of Sidama people (detailed later). During the late 1970s and 1980s, in an attempt to address food insecurity and land shortage, the communist Derg regime subsidized maize production, providing hybrid seeds and fertilizer. Neoliberalism introduced after the fall of the Derg regime in the 1990s, common throughout sub-Saharan Africa (Little 2014), left maize adopters more vulnerable to global fluctuations in prices for maize inputs and surplus sales than was experienced with government subsidies.

Although maize often provides large yields, it is sensitive to annual variations in rainfall. Maize farms have high crop loss rates, twice that of enset farms, but they recover quickly from shocks: nearly 100% of Sidama maize farmers reported household recovery after 4 years of crop failure, compared with 50% of enset farmers reporting recovery in 6 years (Quinlan et al. 2015).

We compare the psychological response of Sidama farmers to crop loss and social shocks in the traditional, lower-risk, long-recovery enset regime and the transitional, high-risk, short-recovery maize regime. These regimes have biological, ecological, and social structural properties evident in different Sidama environments. And these structural characteristics inform and are transformed by Sidama cultural perceptions of subsistence, market potential, and expected environments.

Field and Analytical Methods

Qualitative data were collected via key informant interviews and focus groups to establish recent local history of environmental perturbations, individual accounts of salient events, cultural models of production, and the range of traditional and transitional values in Sidama Zone. Our work was guided by principles of collaborative ethnography (Lassiter 2005) detailed elsewhere (Quinlan et al. 2015). Qualitative interviews and focus groups were translated from Sidama to English by senior project personnel Amalo Sooge and Samuel Jilo Dira during the course of the interviews. Other senior personnel (Robert J. Quinlan, Marsha B. Quinlan, Mark Caudell, and Awoke Assoma) took notes during interviews, which we routinely transcribed within 24 hours and shared with senior Sidama personnel who cross-checked the notes for accuracy while the interviews were still fresh.

Quantitative data were collected by oral self-report questionnaires concerning household demography, health, impulsivity, and production. The instrument included more than

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200 items covering topics yielding data for comparison with other social and economic studies in Africa. Interviewers were five native Sidama, trilingual (Sidama, Amharic, and English) research assistants—four with university degrees and three with prior survey research experience. The research assistants initially received the instrument in English and Amharic, and then research assistants and senior personnel developed appropriate Sidama translations together. Senior personnel field-tested the Sidama language instrument. Then, Sidama research assistants received 1 week of training in instrument administration. During the first week of data collection, Sidama assistants worked in teams of two supervised by senior personnel to ensure uniformity in instrument administration. Surveys took 30–90 minutes to complete. Subsequent quality control checks indicated that one interviewer had substantial difficulty with psychological portions of the interview. Data for this interviewer were excluded from analyses below.

Selecting an impulsivity scale required close attention to linguistic properties of the instrument, number of items, and the cultural relevance of impulsiveness items. Prior pilot research on personality measures indicated that the short form of the BIS (BIS 15; Spinella 2007) was the best mix of language with simple grammatical structures, relatively few culture-bound items (questions about skydiving or driving fast), and a well-documented short scale for inclusion in a longer instrument without substantially contributing to informant fatigue. In general, the BIS shows convergent validity in neuroimaging studies of impulsiveness in clinical populations and reliability and validity that is useful in normative populations (Spinella 2007). However, the BIS-15 required minor modification for a subsistence population with low literacy rates (51% of our sample was illiterate, and 67% did not complete primary school). Modifications included removing items referring to attention in a lecture setting and one item about complex problems that proved difficult to translate. We detail factor structure for BIS items below.

We created a judgment sample of four districts (*woreda*) representing a range of ecological and economic variation in the Sidama Zone. Each Sidama assistant was randomly assigned a different *kebele* (neighborhood) within the district. Within the kebele, assistants obtained a convenience sample, recruiting participants as they encountered adults while walking main neighborhood footpaths. We set a target sample size of 100 for each woreda. When we reached that target, we moved on to the next woreda. This sampling strategy balanced representative sampling and research efficiency. Random sampling of households would have dramatically increased research time and expenses beyond our budget constraints. We did not achieve the target sample in the Lokka Abaya district. Heightened ethnic tension and potential for violent conflict between Sidama and neighboring Wolayta people posed an unacceptable risk for the research team, so we terminated data collection after interviewing 72 Lokka Abaya households. Because we employed multiple interviewers and neighborhoods were randomly assigned, we do not believe our sampling method introduced systematic bias. We do not claim that our analyses represent precise population estimates; however, these data are suitable for generating accurate statistical associations to examine effects on production, risk, and resilience in the Sidama Zone.

Our interest is the environmental activation of impulsiveness in the context of high-risk cultural subsistence regimes versus low-risk regimes. We examine two dimensions of impulsiveness: CC and AWT (described below). Environmental risk is appraised by loss of half or more of crops in the past 5 years as a proxy for economic shocks and by death or serious illness of a household member in the past 5 years as a proxy of social shocks. Alternate cultural ecological regimes for subsistence are indicated by enset or maize as the primary crop (enset = 1, maize = 0), that is, the first crop listed in a mini free list task, followed by self-report ranking of crops by importance. Land, tropical livestock units (TLUs) are the main and most reliable indicators of Sidama assets, which may buffer the effects of shocks on impulsivity. Food aid (1 = received food aid, 0 = did not) and distance from the administrative/market center (minutes on foot) were included as potential buffers of shocks in subsequent analyses. Age, sex, and woreda are controls. In three separate models (discussed below), we examine psychological response to environmental risk with interaction terms for crop loss × regime and social shock × regime. We use a mixed-effects model to adjust for random interviewer effects. Most basic demographic and economic data do not show interviewer effects (nor does ours); however, we have found that psychological and attitudinal data often exhibit significant interviewer effects (Aunger 2004). We treat random intercepts for interviewers as a nuisance parameter in these analyses. Yet translation and interviewer effects in cross-cultural psychological instrumentation are topics worthy of expansion (Gurven et al. 2013; Henrich et al. 2010).

Sidama Farming and Risk

The Sidama are a Cushitic-speaking people inhabiting areas between the Rift Valley lakes of Awassa and Abaya in southwestern Ethiopia (Hamer 1987; see fig. 1). Most Sidama reside in the Southern Nations, Nationalities, and Peoples' Region (SNNPR), the most rural of the nine states in the Federal Democratic Republic of Ethiopia (fig. 1; CSAE 2013). The SNNPR contains 18 zones and special districts, with boundaries demarcated along ethnic lines; hence, most Sidama live in the Sidama Zone (Aalen 2011; CSAE 2013). Census figures estimate 3 million Sidama, the fifth largest ethnic group in Ethiopia (CSAE 2013) in a country with more than 80 distinct ethnicities (Levine 2000).

Sidama say that their ancestors were pastoralists and enset farmers who formed two kinship groups, *Bushe* and *Maldeha*, subdivided into patrilineal, patrilocal, exogamous clans (Hailu and Regassa 2007; Hamer 1987). Traditionally, the economy revolved around subsistence agriculture and barter-based exchange. Sidama traded iron widely and used iron for bridewealth. Since the 1890s, Sidama increasingly incorporated

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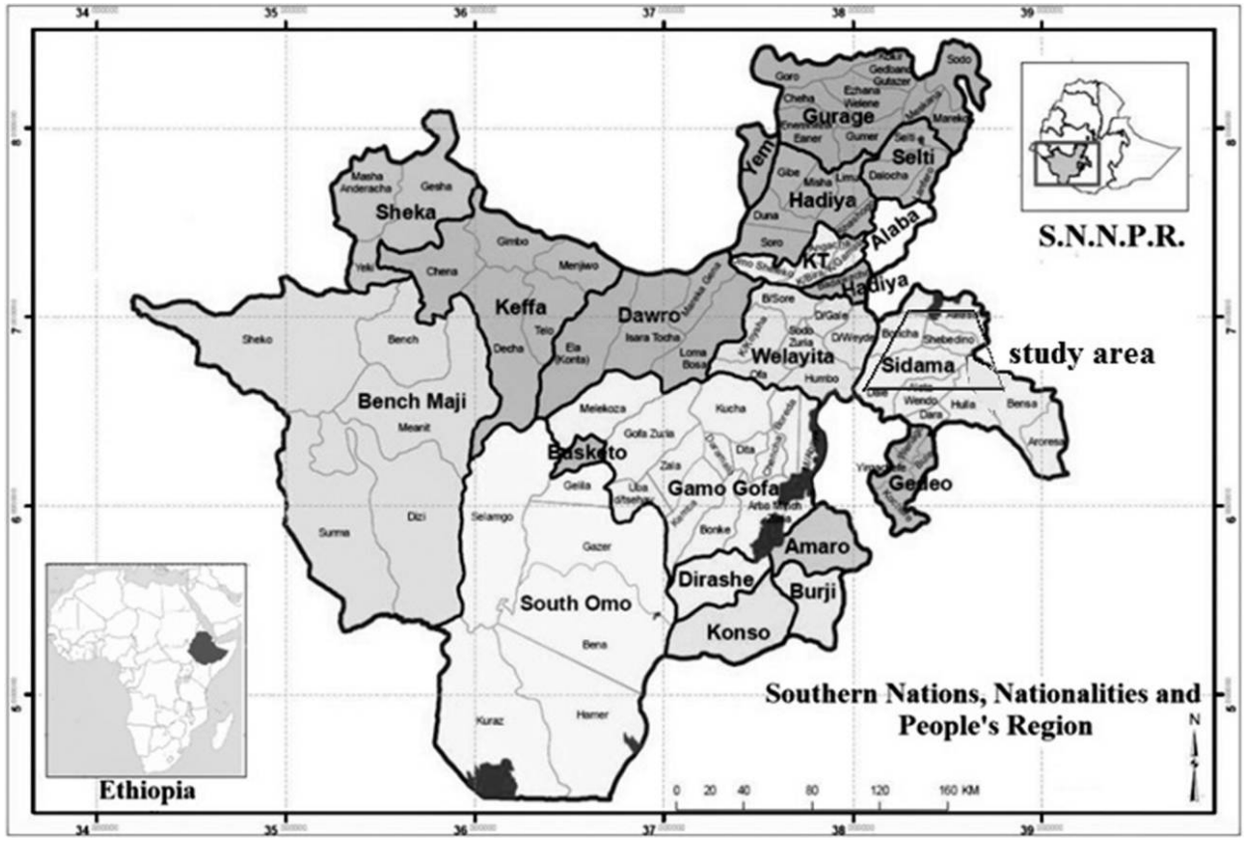

Figure 1. Southern Nations, Nationalities, and Peoples' Region, Ethiopia, and Sidama study area. A color version of this figure is available online.

foreign currencies into their economy (Hamer 2009). Estimates from our unpublished data indicate polygyny for 13% of married men (for similar estimates, see Hailu and Regassa 2007). Polygyny is declining with the spread of Christianity, human immunodeficiency virus (HIV)/acquired immune deficiency syndrome, increases in educational expenses for children, and decreases in wealth (Hailu and Regassa 2007). Around 90% of Sidama identify as Christians, while 6% are Muslim and 3% retain traditional beliefs (CSAE 2013). More than 50% of our sample was illiterate, and 33% had finished primary school. Sidama are generally poor by international standards: they have few consumer items, average landholding is less than 2 ha, average household TLUs is less than 2, and few households earn wages or have cash savings. Fertility is high: women over 42 years of age have 5.8 surviving children on average (Robert J. Quinlan, unpublished data). Given high fertility and minimal land, the subsistence system seems unsustainable without radical changes.

Rural Sidama are generally subsistence agropastoralists (Asfaw and Ågren 2007; CSAE 2013; Hamer 1987). Enset, the main and preferred food in much of the zone, provides more calories per unit area than do most cereals, and it is drought resistant. These characteristics of enset are especially important in southern Ethiopia, given dramatic increases in population density and frequency of droughts in the past 30 years (Asfaw and Ågren 2007). Cattle play an important role in Sidama subsistence and culture (Hamer 1987). Sidama raise zebu cattle, *Bos primigenius indicus*, which they primarily use for dairy and fertilizer. They usually limit beef consumption to ceremonies (e.g., marriage, funeral) or natural death of the animal. Cattle are the main form of household savings, and informal insurance networks depend on connections among cattle owners (Caudell et al. 2015). Sidama also keep goats (arsi-bale Rift Vally goat, *Capra aegagrus hircus*), sheep (Ethiopian menz and horro breeds, *Ovis aries*), and chickens (*Gallus gallus domesticus*) for consumption and sale (Asfaw and Ågren 2007). Sidama generally convert and save cash in the form of livestock (Yilma 2001).

Maize, in contrast to enset, is a newcomer to Ethiopia. First documented in 1623 and accurately identified in 1810, maize was not widespread in Southwest Ethiopia until the mid-1970s (McCann 2001). Several features contribute to maize's spread: it needs only one plowing before planting (other cereals require up to four plowings), available varieties require relatively little weeding, maize has a higher caloric return per kilogram than enset, and it provides a high yield in a short time. However, farmers relying on maize "gambled that the rains would come on time" (McCann 2001:265). Maize is

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also subject to global-scale market processes: Sidama people say maize productivity can be increased by as much 100% by using chemical fertilizer, and 50 kg of chemical fertilizer can double the output of a half-hectare of maize. An empirical study of maize production in the Sidama Zone indicates a 76% increase in maize production per hectare with 50 kg of fertilizer (Quinlan et al. 2015). Sidama farmers said the cost of fertilizer was an important constraint on maize productivity. One bag of fertilizer was approximately 60 Ethiopian Birr (<US$3) in the year 2000 but increased dramatically to 800 Birr (~US$40) by 2012. Price hikes put chemical fertilizer out of reach for most Sidama farmers. Variation in maize productivity and fertilizer costs also contributed to economic insecurity, exacerbating the 2003 famine in Boricha District. Sidama farmers described a bumper 2001 maize crop causing a severe maize price decline, and maize became a less attractive crop in subsequent years. Following the MultiNational Force Iraq War, nitrogenous fertilizer price increased as oil price increased (Wright 2011). Increased fertilizer cost and declines in maize prices set the scene for food insecurity. By 2012, average expense for chemical fertilizer in our sample's most maize-dependent district (Hawassa Zuria) was 382 Birr (Quinlan et al. 2015), not enough to fertilize a quarter hectare of maize.

Our analysis depends on four Sidama communities representing a range of Sidama ecological and geographic variation: Arbegona in the Sidama highlands, Boricha straddling the midlands and lowlands, Lokka Abaya in the lowlands, and Hawassa Zuria in the peri-urban zone of Hawassa city, the capital of the SNNPR. For more detailed site descriptions, see Quinlan et al. (2015).

Arbegona woreda (home to the Harbee and Harbagona clans) is about 74 km from Hawassa city in the highland east of Sidama Zone, bordering Oromia state. The majority of the population practices mixed subsistence agriculture. Arbegona receives substantial rainfall (up to 2,500 mm in long rainy seasons from June to September). At an elevation of approximately 2,600 m, Arbegona is wet and cool. Highland climate buffered Arbegona from drought experienced elsewhere in the Sidama Zone in recent history. However, Arbegona was at the center of armed conflict through much of the 1980s. Many consider Arbegona and other highland areas the archetypical landscape of the Sidama Zone. Arbegona people are almost exclusively enset farmers, and there is a very low risk of crop loss (<3% over 5 years; Quinlan et al. 2015).

Boricha (Yanese clan homeland) is a densely populated woreda in the center of the Sidama Zone, about 39 km south of Hawassa. Elevation ranges between 560 and 1,700 m. Boricha receives bimodal rainfall, ranging from 56 mm during March through May to 180 mm from June through October. Boricha had a recent history of periodic drought leading to famine in 1998–1999, 2001, 2003, and 2008. The woreda was the site of intense relief efforts, including food and development aid in recent years. Enset is the primary crop for most Yanese, but they also grow maize as a secondary crop (Quinlan et al. 2015). Five-year crop loss rates are high (47%; Quinlan et al. 2015).

Lokka Abaya woreda is at the western border of the Sidama Zone, located about 50 km southwest of Hawassa. The topography is flat, with a downhill gradient from east to west toward Bilate River, with an elevation of 560–1,700 m. This is a low-precipitation area with erratic rainfall during two rainy seasons, the *belg* rains (February–April) and the *kiremt* rains (July to early October). This district's recent drought history is similar to Boricha. In addition to occasional drought and famine, the Sidama people of Lokka Abaya experience periodic armed conflict with the neighboring Wolayta people (Aalen 2011). Enset is the primary crop for most people in Lokka Abaya, but they also grow maize as a secondary crop, and 5-year crop loss is high (51%; Quinlan et al. 2015).

Hawassa Zuria woreda is along the shores of Lake Hawassa within a less than 1-hour bus commute to Hawassa city, capital of the SNNPR. Average elevation is 1,700 m, with mean annual rainfall ranging from 900 to 1400 mm. Hawassa Zuria is dependent on maize as the primary crop, and 5-year crop loss risk is highest of all four woreda at 57% (Quinlan et al. 2015).

Oral History of Sidama Systemic Shocks

Drying climate and related food insecurities destabilize communities. The vast majority of the world's armed conflicts occur in vulnerable dry ecosystems (UNCCD 2014), compounding other regional shocks. Our interviews with Sidama elders reveal a recent history replete with a series of major shocks, including war, drought, famine, disease, and disintegration of traditional regulatory and cooperative institutions. The following are edited excerpts from field notes indicating the typical range of environmental and social shocks experienced over the past half century in the Sidama Zone.

Drought, Crop Loss, and Famine

Gobaro and Sarmiso, elderly men in the Boricha woreda, shared their memories about the climate with us. Gobaro said that he was 120 years old, then he pointed to his 12-year-old grandson, indicating that he was about that age at the beginning of the Italian occupation, making Gobaro approximately 90 years old. Gobaro stated that until about 40 years ago, Boricha was green and there was plenty of rain. There was enough rain for people, crops, and cattle. Sarmiso, who is about 80 years old, recounted that years ago, though their community in Boricha had no river, water was not a problem. There was rain, and they had enough water. People came together to help each other dig big catchment holes to collect rain water for people and cattle: "During the rainy season, the holes would fill up and provide enough water for the entire year." Sarmiso added, "Every year, just at the end of the dry season, people cleaned out the holes in preparation for the next rainy season. There was plenty of water then." These catchment holes have since fallen into disrepair, and weeds have taken over.

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Gobaro emphasized that the weather became dry, as it is now, beginning in the 1970s, near the end of Haile Selassie's reign. Despite our prompts, neither he nor his adult sons, who joined us, were able to identify a specific drought until 1985. In 1985, Boricha was hard hit by the Great Ethiopian Famine of the mid-1980s, the result of drought and war. Sarmiso and his son recalled that the dry period did not start all at once, but gradually over time, each year had a little less rain, until finally in 1985 there was a serious drought. Sarmiso said that after the 1985 drought, the rains returned, and slowly his farm began to produce again, but it never returned to the productivity he had before that drought.

Gobaro and his sons indicated that recent droughts in 2003 and 2009 had not been as serious as in 1985 but were "more like this year [2012]. Normally, the rainy season begins in January … but this year [as in 2008–2009] the rain did not come until much later. When the rains are late, crops suffer, and sometimes the late rains are not enough. Now they have to bring in water from other places and pay as much as 10 Birr for one jerrycan." Sidama repeatedly told us that the rain is "not reliable" like it used to be. "In some dry years, we don't even try to harvest maize, but just leave it in the field for cattle to graze."

Idalya, an elderly woman from Boricha, told us, "In the old days, only 4 months were dry, and what we grew during the rainy season we used to eat for a long time." She explained that the harvest is in September, and there was always plenty to eat: "We used to have enough food to last the whole year, and even had food left from the previous year when the harvest came in. But in recent decades, it is not like this. It has been dry. There have been droughts and crop failures. There is not enough to eat."

In contrast, highland Sidama in Arbegona are not rain stressed. The highlands tend to be very wet in all but one 3-month season. It was a coincidence that during the Great Famine of 1983–1985, some highland enset areas suffered a bacterial wilt disease (*Xanthomonas campestras* pv. *musacearum*; see Ashagari 1985), while drought wiped out crops at lower elevations. Most highland Sidama remained unaffected by drought. When we asked 60-year-old Ishine about the 2003 and 2009 droughts, he said, "I heard about it. There was even drought in [neighboring] Bensa. It was hard on most of Sidamaland, but not in Arbegona. There was really no problem here. Things were as they are now."

Among Sidama agropastoralists, drought devastates not just crops but the entire balance of the system. We asked one middle-aged man how drought affected his cattle, and he replied sympathetically, "It is difficult to say, but cattle suffered just as the people did." He noted that people traded cattle for grain to eat during hard times, leaving them no way to recover their investment: "In the old days, a high-status person might have 20 cattle. Now, a high-status person has maybe five cattle." Another man of 60 years added, "In the past . . . they had large corrals. They had more variety of breeds. . . . Back then, the price of cattle was very low. Now one cow will bring a high price. The prices have gone way up." Similarly, Sarmiso, a Boricha elder, explained:

> Cattle and especially milk cows are important for food and status. During the drought, people would sell their only milk cow to buy maize to eat. They would sell one milk cow for 1 *quintal* (100-kg bag) of maize. Before the drought, 1 quintal cost 35 Birr. By the time the drought was severe, 1 quintal was up to 100 Birr. I had saved up 8 quintals of maize that I sold in Hawassa at the height of the drought. I had so much money, I had no idea where to put it. During those years [mid-1980s], people here sold off so many cattle that the cattle population never recovered.

Multiple Sidama told us that nowadays they need commercial fertilizer to be nearly as productive as in the old days, but price increases put fertilizer out of reach for many Sidama farmers. They explained to us that one-half hectare of maize, fertilized, yields 6 or 7 quintals (bags) of corn. Without fertilizer, that same one-half hectare yields about 3 quintals—much less if it is a dry year. They said that they began using fertilizer during the Derg regime years, when seeds and fertilizer were subsidized; before that, there was no chemical fertilizer.

In highland Arbegona, enset remains the primary and almost exclusive staple crop, but even there they farm less of it than in the past. Sixty-year-old Ishine said, "We used to produce a lot more [enset], but now we have less land and produce less. Now land is relatively scarce—population growth has made it scarce. There is also less variety of crops."

People said that they value enset for its hardiness. Enset is generally drought resistant for short periods (Brandt et al. 1997; Mohammed et al. 2013). In 1985, Gobaro lost all of his maize "and everything else except enset." Gobaro and his sons emphasized that enset is the only crop that survives drought, and that without it they could not continue here (in Boricha). Gobaro and his sons mentioned repeatedly that enset is very important for living here in this dry area. People and cattle rely on it, because it is the only drought-resistant crop they have. Gobaro motioned toward the cattle eating enset leaf stalks.

Warfare and Violence

Ethiopia had a long imperial period from approximately 1137 CE until 1974, when Emperor Haile Selassie was deposed. There was tribal conflict within the empire, including among Sidama. For example, Ishine, a Sidama man of about 60 years, recounted a war between the Sidama and the Oromo when he was a young boy around 1960:

> There was a war, an ethnic conflict between the Sidama and the Oromo. People ran away from their farms. Men abandoned their farms to go become heroes in the war. No one was working the farms, and so there was no food. People had no food, and they ate grass. Many people died. The women and children had to move to escape the fighting. My family ran away to Aleta. There was fighting with the Amhara [majority ethnic group] too because the Amhara [i.e., Amhara

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government troops] came to control the conflict between the Sidama and the Oromo.

In 1974, the communist Derg regime overthrew Emperor Haile Selassie in a coup d'etat. Thereafter, opposition to the Derg reign caused the Ethiopian Civil War, which was brutal on both sides, including executions, torture, imprisonment without trial, and the loss of 1.4 million lives (Valentino 2004; Young 1997). Many Sidama were killed during the Civil War. In Sidamaland, the Derg redistributed rural land from nobility and landlords; however, excessive socialization measures such as nationalization of land and resettlement curtailed smallholders hope of autonomy and self-rule (Kinkino 2013). After the 1974 Derg coup, the Sidama split into two factions: Derg supporters and the guerilla Sidama Liberation Front (SLF; Kinkino 2013). Warfare escalated in 1981 when the antigovernment SLF movement stepped up its activities (Hamer 1996).

Tona, a 65-year-old man, explained that after the Derg came to power, the fighting over borderlands continued between the Sidama and Oromo. Tona was a Sidama officer (called *meto alike*, chief of 100 men, in Amharic), and he would stay away from home, fighting for 2 months at a time, while his wife and children took care of his farm and armed guards protected the village against Oromo raiders. After those conflicts, there was peace for a few years until about 1981, when the Sidama rebellion began.

Koroso and Lencha, friends and elderly men, were emphatic that the hardest time the Sidama ever endured was during the Sidama Rebellion, when some Sidama (SLF) were fighting against the Derg and their Sidama militia allies. They explained that some men went off to the forest to train with the SLF. When those men returned, "They targeted only Amhara [government outsiders] at first, but soon they were killing everyone." Koroso and Lencha corroborated what several others had shared, that the SLF came through the Arbegona highlands, took all of the cattle, abducted many women, and killed many men. Koroso and Lencha noted that some men tried to join the SLF in hopes of getting their cattle and women back. They followed the SLF back into their forest hideout. Sometimes the Derg troops would catch the men following the SLF and kill them. During the dry season, forest foliage was less dense, and the Derg army sent helicopters to find the SLF camps, drive away, and kill the SLF. Some Sidama moved back to their homes during the dry season, when the SLF were suppressed. But in the rainy season when the forest was lush, the helicopters could not find the SLF in the forest, and they resumed raiding the local farms. Many local farmers ran away from their woreda and the SLF.

Tona, the chief of 100 men in the pro-Derg militia, explained that most people lost cattle to the SLF. "During the rebellion, we could hear gun fire in the distance," he said. When he heard that, he arranged to move his cattle to a safe place. First, he moved them to his dry season place and then later to another area. While Tona's uncle was attempting to drive a combined herd of Tona's and his uncle's cattle to safety, the rebel SLF killed his uncle. "It happened just down there by the river," Tona said, gesturing to the river, about 150 m away. For safety from the SLF, Tona moved his family from the countryside to the town of Yaye, where men were posted to defend the town. The rebels burned one end of the town, but they never captured the whole town.

After the war, it took Tona about 3 years to recover his farm. He was fortunate not to lose cattle or crops to the SLF. In his abandoned fields, he lost many—especially smaller—enset plants to pests, but with cattle intact, he recovered. Tona says it took other Derg supporting families longer, maybe 5 or 6 years, to recover. Families of SLF members took the longest to recover: "When someone went with the rebels, the Derg forces would destroy his house and crops, and he would have to start again from nothing after the war." Tona said that it took those families a long time, more than 6 or 7 years, to recover. Others told us that many families never recovered from the war.

Violent conflicts occasionally still occur in the Sidama Zone. Long-standing tensions between Sidama and neighboring Wolayta in Lokka Abaya woreda flared over control of the regional capital of Hawassa during our visit in 2012.

Disease and Epidemics

The most devastating human disease that Sidama mentioned was a smallpox epidemic during the mid-1950s. Many people were affected, young and old alike. An Arbegona man recalled that there was a kind of stigma attached to smallpox. Healthy people would not get close to sick people. They would bring food to the sick people, leave it by their door, and run away. Many people died. The epidemic lasted for about 3 years. The outbreaks were kind of isolated, and it did not affect everyone in a village because people would stay away. Then there would be another case in another village. He said that smallpox had affected subsistence during those years because some people could not work while they were sick and some people died. But the livelihood rebounded shortly after the epidemic passed.

Several Sidama indicated that the human disease called *ajiite* was a serious periodic problem. The worst outbreak of it happened during the reign of Haile Selassie. There was no treatment for it then, but the Derg introduced effective treatment. Ajiite includes a bad headache, fever, and bloody nose. People lose all appetite. The disease comes at the end of the rainy season, and outbreaks last for about 3 months. A single outbreak used to kill many people. In the worst cases, people would get sick and die within about 15 days.

Another human disease, *'xanne* (typhus), causes bloody diarrhea, severe stomachache, and loss of appetite, and it kills many people. This epidemic came about 40 years ago and is better treated now, though people still get it sometimes.

The 2004 HIV prevalence rate for rural Ethiopia, including Sidamaland, was estimated at around 3% (SNNPR Regional Health Bureau and AIDS Secretariat 2003; UNAIDS and WHO

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2004). Awareness of the disease changes traditional behaviors, such as nursing another mother's child. One mother explained, "You can't let another woman, even your sister, feed your baby anymore because you can't know a person's health status."

Institutional Shocks

Ishine, a 60-year-old man, explained that when he was young, the elders had a lot of power, and they decided how to live. Everyone listened to them. They would solve conflicts and organize cooperation. The coming of Christianity changed things a lot. Christianity made people more individualistic, but conflict was reduced a lot, and people became more peaceful. Now the government, rather than elders, solves conflicts between people. Other Sidama indicated that the Derg regime targeted the traditional generational *luwa* system, whereby male elders coordinate collective action and resolve disputes. Young (college student) Derg organizers stripped the elders of their traditional power, even forcing respected elders to "pick up cow shit," as they reorganized Sidama cooperation into neighborhood self-help cells.

Some people said that the newly individualistic Sidama are not as collaborative as the Sidama were in the past. See Ellison (2006) and Watson (2006) for parallel increases in individuality among nearby Konso people in response to market liberalization (Little 2014). For example, when we asked Gobaro and his sons what they think caused the change in the weather 40 years ago, they responded that only God knows, adding that in the old days, people would come together to pray for God to send rain: "Today there is a breakdown of society, and there is no respect for such traditions. People do not come together like they used to, but they pray on their own for rain."

Dimensions of Sidama Impulsiveness

Sidama language has no word for impulsiveness. *Baashicha* comes close. Baashicha derives from *baashe*, a term meaning deficient used to describe undesirable resource availability or scarcity in the midst of plenty. Baashe is a state in which people may farm a large piece of land but earn less yield, where there are much higher food prices than expected, and where costs of basic needs are more than the value of basic commodities. In a baashe world, established norms erode, respect for elders is not observed, and traditional cooperative networks become dysfunctional. People can be baashicha when they seem to have a lot but are unable to save, they spend their wealth on trivial things, and they are careless with their possessions. A baashicha person is cavalier, behaving outside of established cultural models. They are disobedient children, youths disrespectful to their elders, and spendthrifts.

We used the BIS with Sidama people. Through exploratory factor analysis, we developed two scales of impulsiveness approximating self-regulation and impulsive behavior (Morean et al. 2014). We started with eight BIS items, following Morean et al. (2014). We set the minimum criteria for the scale as follows: (1) each item must load $\geq |0.5|$ on one factor, (2) each factor must have at least three items, and (3) cross-loadings must be <0.32 (Morean et al. 2014) The eight-item factor solution using varimax rotation gave two factors (not shown), with two items loading <0.5: "I concentrate easily" loaded at -0.26 on the second factor, and "I act on impulse" loaded at 0.42 on the second factor. "I act on impulse" was a replacement for "I act on the spur of the moment," for which we could not develop an acceptable Sidama translation. "Act on impulse" and "act on the spur of the moment" come from the same packet of BIS items (Morean et al. 2014). We removed the two items with low loadings and repeated the analysis, yielding the factor solution in table 1 comparing Sidama factors with item loadings reported for a US population (Morean et al. 2014). We labeled the first factor CC, with positive loadings for "I plan tasks carefully," "I am self-controlled," and "I am a careful thinker" (table 1). Cronbach alpha for items loading on CC was 0.68, indicating useful reliability. We labeled the second factor AWT, which had positive loadings for "I say things without thinking," "I do things without thinking," and "I don't pay attention." Cronbach alpha for items loading on AWT was 0.61, indicating minimally useful reliability.

Effect of Shocks on Impulsivity in Traditional and Transitional Regimes

Descriptive statistics are shown in table 2. About 77% of our sample indicated that they were primarily enset farmers; 35% experienced crop loss in the past 5 years, and 26% experienced social shocks.

Model 1 (table 3) shows that experience of social shocks was associated with decreased CC by about 60% of 1 SD ($P = .004$). Crop loss also showed a marginally significant association with reduced CC ($P = .055$). The interaction between farming regime and social shock was associated with increased CC ($P = .066$) of 42% of 1 SD, but again P values were high. This trend suggests that effects of social shocks on CC are moderated by enset farming: enset farmers show little change in CC in response to social shocks, while transitional maize farmers showed decreased CC in response to social shocks (fig. 2).

Model 2 (table 3) showed an interesting pattern of associations relative to model 1: crop loss was associated with significantly increased AWT ($P = .023$) of 49% of 1 SD. Social shocks were also significantly associated with higher AWT ($P = .036$). The interaction between crop loss and enset farming was associated with decreased AWT ($P = .034$), similar to the interaction effect of social shock and enset on CC. This suggests that effects of crop loss on AWT are moderated by enset farming: Enset farmers show little change in AWT in response to crop loss, while transitional maize farmers showed increased AWT in response to recent crop loss (fig. 3). Social shocks were associated with increased AWT for both subsistence regimes.

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Table 1. Factors of Sidama impulsiveness compared with a US sample

Item	Careful control	Act without thinking	Self-regulation[a]	Impulsive behavior[a]
I plan tasks carefully	**.65**	−.22	**.62**	
I am self-controlled	**.60**	−.12	**.66**	
I am a careful thinker	**.53**	−.12	**.65**	
I say things without thinking	−.15	**.57**		**.54**
I do things without thinking	−.12	**.54**		**.73**
I do not pay attention	−.30	**.51**		**.53**

Note. Boldface indicates factor loadings >0.5.
[a] Factor loadings reported for US Center for the Translational Neuroscience of Alcoholism data by Morean et al. (2014).

AWT also showed significant variability across the four woreda. Lokka Abaya (mixed enset and maize with recent interethnic conflict) and Hawassa Zuria (predominantly maize farmers in the regional capital peri-urban zone) showed higher levels of AWT by 0.76–0.87 SDs compared with Arbegona (highland wet enset) and Boricha (mixed crops and recent intensive nongovernmental organization activity). This finding supports the context dependence of impulsivity: Sidama practice local (clan) exogamy, and Lokka Abaya is only about 10 km from Boricha, suggesting a lack of genetic effects.

We tested for mediating effects of food aid and distance from the administrative center. Neither was a significant predictor of CC or AWT, nor was the pattern of associations changed compared with models 1 and 2 (analysis not shown). Model *P* values were slightly higher, as one would expect. We also tested moderating effects of assets, TLUs, and land. Interactions were not significant, nor were other associations appreciably altered.

Results thus far show a potentially interesting pattern; however, the question remains whether impulsiveness results from shocks or causes shocks. It is possible that people scoring higher on AWT and lower on CC could increase their probability of crop loss (or possibly social shock) by careless management of resources (resourcelessness in Sharma et al. 2014: 380). If so, then we expect AWT and CC to be associated with agricultural productivity, geographically adjusted for soil quality and rainfall. Simply, if crop loss is induced by poor farming practices among impulsive people, then impulsive people should show evidence of lower production in years without a crop loss. We used kilograms produced per hectare as a measure of efficiency, controlling for geography. The distribution of kilograms produced per hectare was skewed toward the high end, with several farms showing extraordinary production per hectare. We Winsorized the top 10% of farm production per hectare to adjust for the skew. We then examined associations between CC and AWT and farm productivity, controlling for age, sex, TLUs, fertilizer expense, and woreda. Table 4 shows that neither CC nor AWT is associated with farm productivity, suggesting that impulsiveness does not cause crop loss through resourcelessness.

Discussion and Conclusions

This study demonstrates that two psychometrically robust dimensions of impulsivity—mapping onto self-regulation and impulsive behavior (Morean et al. 2014)—are differentially activated in response to social and economic shocks in transitional and traditional Sidama subsistence regimes. We dis-

Table 2. Descriptive statistics for predictor and control variables

Variable	*N*	Mean	SD	Minimum	Maximum
Age	331	39.272	16.989	12	100
Tropical livestock units	331	1.933	2.485	0	26.6
Land (ha)	331	2.000	1.784	0	10
Minutes from administrative center	331	26.159	22.719	0	240
Sex	331	.568		0	1
Received food aid	331	.293		0	1
Arbegona	330	.264		0	1
Boricha	330	.258		0	1
Lokka Abaya	330	.188		0	1
Hawassa Zuria	330	.291		0	1
Crop loss in past 5 years	331	.350		0	1
Social shock in past 5 years	331	.263		0	1
Enset primary crop	328	.765		0	1

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Table 3. Mixed-effects models showing effects of social shocks and crop loss on careful control (CC) and acts without thinking (AWT)

	Model 1 (z-CC, $P = .009$)		Model 2 (z-AWT, $P < .001$)	
	β	P	β	P
Age	−.001	.757	−.003	.387
Sex (1 = male, 0 = female)	−.038	.683	.113	.301
Boricha[a]	−.005	.874	.067	.703
Loka Abaya[a]	.027	.165	**.764**	**.000**
Hawassa Zuria[a]	−.181	.235	**.871**	**.000**
Land	−.110	.471	.027	.488
Tropical livestock units	−.138	.431	.006	.790
Crop loss (1 = yes, 0 = no)	***−.359***	***.055***	**.495**	**.023**
Enset primary (1 = yes, 0 = no)	−.093	.617	.163	.450
Crop loss × enset primary	.189	.401	**−.554**	**.034**
Social shock (1 = yes, 0 = no)	**−.608**	**.004**	**.508**	**.036**
Social shock × enset primary	***.423***	***.066***	−.234	.380
Constant	.386	.309	−.826	.010
Variance(constant)	.580		.300	
Variance(residual)	.758		.882	
N	318		318	
No. groups	4		4	

Note. z-CC and z-AWT are standardized factor scores. A 1-unit change in predictor and control variables is associated with a β change in the standard deviation of the criterion variable. Variance(constant) and variance(residual) indicate the random interviewer effects. Boldface indicates $P < 0.05$; italics indicate $P < 0.10$.

[a] Indicates that Arbegona was the reference population.

cuss the study's limitations before turning to a radical proposal for the role of impulsivity in human agency and niche construction.

Limitations and Future Prospects

If it were easy to demonstrate ecological validity of psychological constructs in cultural context, then there would be hundreds of studies doing so, but there are few (e.g., von Rueden et al. 2015). Problems arise in the construction and translation of methods and concepts for use in tribal populations (Henrich et al. 2010). The nature of self-concepts and ways of thinking and talking about thinking vary from people to people and place to place (Bloch 2012). Translating instruments and field experiments is not merely transliteration but a problem of identifying what makes sense to people who may be very different from the observer. Instrument items concerning concentration, paying attention, and thinking about complex problems (all included in the BIS-11 [Spinella 2007]) are, we think, items that tap patterned practice for classroom environments targeting skills development in industrial regimes. They may make little sense to the people outside education-based labor markets (Kaplan 1996). At minimum, careful attention to language for cross-cultural psychometrics is indispensable.

Administration of these instruments depends on item interpretations from self-constructs potentially very different from constructs assumed by instrument developers. Strawson (2005) distinguishes diachronic and episodic personality styles. A diachronic person is "one [who] naturally figures oneself, considered as a self, as something that was there in the (further) past and will be there in the (further) future—something that has relatively long-term . . . continuity, something that persists over a long stretch of time, perhaps for life." An episodic or (we prefer) synchronic person is "one [who] does not figure oneself, considered as a self, as something that was there in the (further) past and will be there in the (further) future" (Strawson 2005:430). We concur with Bloch (2011) that diachronic self-

Figure 2. Interaction effect of social shocks on careful control. Enset indicates enset farms that experienced social shocks; maize indicates maize farms that experienced social shocks.

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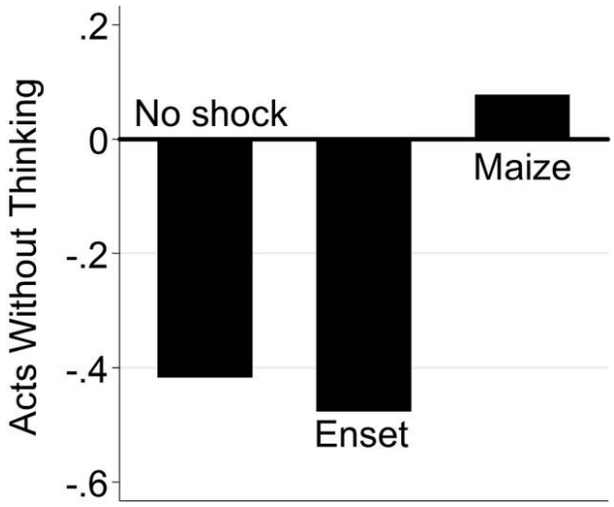

Figure 3. Interaction effect of crop loss on acts without thinking. Enset indicates enset farms that experienced crop loss; maize indicates maize farms that experienced crop loss.

constructions may be more common in Western résumé or curriculum vitae regimes. How one responds to Likert options "rarely/never," "sometimes," "often," and "almost always" (in the BIS) depends on whether one taps diachronic or synchronic self-constructs. Likewise, whether one considers 50% of unexplained variance in 1-month test-retest correlations (Stanford et al. 2009) as evidence of stability depends on one's enthusiasm for universal diachronic self-constructs. We predict that measures of diachronic self-constructs are positively associated with test-retest correlations in other personality dimensions.

Methodologically, these problems seem peculiar to attitudinal and psychological questions as opposed to economic or demographic items. WEIRD translations arise repeatedly with multiple interviewers for data collection in our experience (see Aunger 2004) and, at minimum, require statistical control. The issue is akin to cultural consensus (Weller 2007). Not a mere methodological nuisance, the question is at the heart of culture theory. Future developments in ethnographic science can substantially contribute to robust, eclectic, and relevant culture theory by expanding multilevel analytical frameworks to include properties of observers as key variables in analyses (Aunger 2004).

A Radical Proposal for Impulsivity in Human Agency and Niche Construction

At first glance, cognitive science and social-ecological systems have little in common. Beneath the surface there is a useful synthesis: cognitive science imagines mechanisms from which agency may emerge (Clark 2013), and social-ecological systems theory searches for agency in analyses relevant to human ecological behavior (Davidson 2010). Both are aware that surprise is important (Clark 2013; Folke 2006; Walker et al. 2004). Agency and surprise are intimately intertwined, and we contend that impulsivity promotes agency in the face of big surprises.

In bidirectional predictive perception, linked mental representations of the world predict personal experiences in specific contexts. A good match between representations and recurring experiences produces little surprise, so a person can behave accordingly: just keep doing what the top-down model suggests. When people seek environments that match their predictive models, minimizing surprise becomes a focus of attention and action (Clark 2013). This process of allocating attention is, we think, the psychological property of an ecological basin of attraction in stable equilibrium. Agency is activated in response to surprise to move the individual to a position in the stability landscape that matches her cultural representations.

Surprise is huge when catastrophic system failure makes top-down models useless for action. Then, agency does not seek out a better fit with existing models but reorganizes by seeking new experience to generate and test hypotheses about the unpredictable environment (Friston et al. 2012). Impulsivity—lack of premeditation, sensation seeking, poor self-regulation, delay discounting, and so on—is a cluster of psychological mechanisms responding to surprise by shutting up chatter from higher-order cultural representations that fail to predict sensory input and by turning up sensory input through more intense interaction with the external world. Impulsivity encourages exploration of new environments and discourages the influence of traditional attractions. The goal of impulsivity, then, is active niche construction.

Table 4. Mixed-effects models showing effects of careful control (CC) and acts without thinking (AWT) on farming efficiency (kg/ha) for farms that did not experience crop loss in the most recent year

Winsorized kg/ha	β	P
Age	.953	.455
Sex	−5.757	.889
Land	**−64.269**	**.000**
Winsorized tropical livestock units	15.940	.196
Fertilizer expense	**.221**	**.002**
Boricha[a]	**−227.644**	**.000**
Lokka Abaya[a]	**−250.246**	**.000**
Hawassa Zuria[a]	−58.131	.405
Enset primary	**−158.851**	**.016**
z-CC	22.372	.369
z-AWT	10.763	.616
Constant	751.242	.000
Variance(constant)	125.388	
Variance(residual)	294.096	
N	247	
No. groups	4	

Note. See also Quinlan et al. (2015). Boldface indicates factor loadings > 0.5.
[a] Indicates Arbegona as the reference population.

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Comments

Willem E. Frankenhuis and Jennifer Sheehy-Skeffington
Behavioural Science Institute, Radboud University Nijmegen, Montessorilaan 3, PO Box 9104, 6500 HE, Nijmegen, The Netherlands (wfrankenhuis@gmail.com)/Department of Social Psychology, London School of Economics and Political Science, Houghton Street, London WC2A 2AE, United Kingdom (j.a.sheehy-skeffington@lse.ac.uk). 20 IV 16

Psychological Responses to Fluctuating Environments

Much research has focused on the social systems and institutions that develop in response to unpredictable fluctuations in resources. For example, societies might buffer against shortfall by storing or diversifying resources or by sharing them within and between communities (Winterhalder 2007). By contrast, Quinlan et al. focus on individual-level psychological responses to fluctuating resources.

Quinlan et al. propose that exposure to unpredictable fluctuations in resources increases impulsivity. The logic of the hypothesis is that when environmental conditions are different than they were before, individuals experience a discrepancy between their current mental models of the world and their incoming sensory input. Individuals seek to resolve this discrepancy (not necessarily consciously) by collecting information about the current conditions. Spawning novel behaviors facilitates this discovery process: current conditions will differentially reinforce behaviors, enabling individuals to select the high-performing ones. Impulsivity, according to Quinlan et al., is the psychological generator of novel behaviors: it allows individuals to depart from their present mental models and learn about current conditions. This hypothesis is, to our knowledge, original.

Quinlan et al. test their hypothesis in a study of the Sidama people of Ethiopia. Some Sidama groups earn their living by traditional enset agropastoralism and others by transitional maize farming. Enset production is low risk and low yield, and it recovers slowly after crop loss. Maize production is high risk and high yield, and it recovers quickly after crop loss. Quinlan et al. examine whether the association between impulsivity (two types: careful control and acts without thinking) and environmental risk (two types: economic shocks and social shocks) differs between these subsistence regimes. Their results are complex but overall suggest that the impulsivity levels of maize farmers, who experience greater fluctuations in resources compared with enset farmers, are more responsive to environmental risk. This result seems to be consistent with the impulsivity as exploration hypothesis.

Exploration in Response to Fluctuation

One assumption of Quinlan et al.'s argument is that it is adaptive to spawn novel behaviors and select high-performing ones in fluctuating environments. Whether this is true depends on several factors (Frank 1997). For example, it might not be adaptive to try out behaviors if the costs of maladaptive behavior are extremely high, as they might be in the case of learning about dangerous predators (Barrett, Peterson, and Frankenhuis 2016). However, in many conditions, reinforcement learning does provide a versatile mode of adaptation, as evidenced by mathematical modeling (Sutton and Barto 1998) as well as its ubiquity in the natural world (Snell-Rood 2012). Empirically, it would be interesting to examine whether in fluctuating environments, humans are indeed more likely to explore novel behaviors. A future study could investigate this question by comparing the range of the behaviors that Sidama maize and enset farmers use for the production of their crops and by tracking whether the frequency of novel behaviors among maize farmers increases after changes in environmental conditions more than among enset farmers.

Impulsivity as Exploration of New Cultural Frames

A separate question is whether impulsivity is the right process for generating novel behaviors. Quinlan et al. do not define impulsivity but rather describe it as a cluster of psychological tendencies that includes a lack of premeditation, sensation seeking, little self-regulation, and discounting of future over immediate rewards. Most psychologists agree that there are different subtypes of impulsivity, although opinions differ over which subtypes exist. One distinction is that between temporal impulsivity (a preference for immediate rewards) and reflection impulsivity (acting without gathering or evaluating information; Caswell et al. 2015).

Because temporal impulsivity entails action aimed at immediate rewards, it will also involve a focus on the present over the future (Fujita 2011). A challenge to the linking of temporal impulsivity with exploration is the robust set of findings from psychology that attention toward temporal proximity is associated with attention toward spatial proximity: if one is focused on the now, one is also likely focused on the here, a

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state unconducive to exploration of elsewhere (Trope and Liberman 2010). Thus, any exploration resulting from impulsive behaviors would be local.

A challenge to the linking of reflection impulsivity with exploration is that acting without gathering information seems incompatible with impulsivity as information seeking. One might reconcile these notions, however, with the observation that reflection impulsivity concerns (little) information gathering before acting, and Quinlan et al.'s notion concerns information gathering after acting, on the basis of the consequences of one's actions. If so, the authors might expand their proposed behavioral response to environmental fluctuation from that of "don't think, act" to "act first, then watch to see what happens." A second concern about reconciling reflection impulsivity with cultural exploration is that impulsive behaviors do not necessarily involve rejection of a cultural pattern: in fact, some impulsive behaviors involve mindlessly going along with a cultural ritual or norm (such as a dance or an eating habit), for the sake of immediate rewards; conversely, culturally anomalous behaviors (such as refraining from procreation) may result from reflective, self-controlled information processing.

Impulsivity as an Adaptive Focus on the Present

We suggest that impulsivity be construed in line with the approach of life-history theory, namely, as an adaptive regulatory shift toward the present in response to shocks (whether social or crop related) received in unpredictable environments (Belsky, Steinberg, and Draper 1991; Ellis et al. 2009; Frankenhuis, Panchanathan, and Nettle 2016), the latter arguably characterizing the life of the maize farmer. A version of this explanation would fit well with Quinlan et al.'s evidence of greater regulatory shifts in response to environmental shocks in Sidama maize than enset farmers—evidence that makes a solid contribution to a growing literature on the evolution of plasticity in readiness for the fluctuations of life.

Elliot Fratkin
Department of Anthropology, Smith College, Northampton, Massachusetts 01063, USA (efratkin@smith.edu). 9 XI 15

This article presents the findings of an extensive study of decision-making in response to shocks among Sidama farmers in southwestern Ethiopia. This research draws on a variety of theoretical approaches, including social-ecological systems, niche construction, cognitive science, psychometrics, and cultural ecology. The authors compare two types of impulsivity, defined as behavioral responses that lack premeditation and that can help deal with environmental, social, and economic shocks: "We suggest a pathway whereby unstable environments result in psychological responses—including impulsiveness—as a means to generating adaptive action."

Nearly all agrarian societies must face adjustments to their farming regimes because of climate change and socioeconomic challenges, including increased drought (sometimes combined with torrential rainfall) and fluctuations in the market economy affecting both costs and prices. The Ethiopian Sidama have an ancient adaptation to their tropical highland environment through their farming of enset (false banana), a hardy and drought-resistant food crop. But as the authors show, its slow growth and long food preparation have led to the adoption of maize farming by certain Sidama communities. Maize has been present in Africa since the seventeenth century and provides the main source of calories through its high productivity and capacity for storage of grain. Yet maize is a risky crop, thirsty in normal times and particularly vulnerable to drought.

The authors pose a very interesting question: how does the psychological process of impulsivity work in a long-term agrarian society that must reckon with environmental shocks in terms of choosing between the stable, traditional enset regime and unstable, transitional maize regime? The authors ask, "What psychological processes facilitate culture change, and when are they activated?" In gathering their evidence, the authors try to reduce Western bias by situating behaviors in their cultural context, utilizing a team including Ethiopian anthropologists employing a variety of methods, including psychosocial measurements, economic surveys, qualitative interviews, and focus groups among 372 individuals living in a variety of settings. In this way the authors build a comprehensive inventory of risk aversion strategies based on political, cultural, economic, and environmental factors, and they identify impulsivity as an adaptive strategy in risky environments.

By integrating concepts of cognitive science with environmental studies and particularly ecological systems theory, the authors have applied an imaginative and useful basis to compare economic strategies. The authors write, "Cognitive science imagines mechanisms from which agency may emerge . . . and social-ecological systems theory searches for agency in analyses relevant to human ecological behavior. . . . Both are aware that surprise is important. . . . Agency and surprise are intimately intertwined, and we contend that impulsivity promotes agency in the face of big surprises."

This is a handsome piece of work, one that hypothesis-testing anthropologists could put to use in other contexts. It would be interesting to expand this study of impulsivity to livestock production, which the authors note is important to the Sidama. Pastoralism also requires strategizing and impulsive decision-making, such as when to cull the herd or develop specialized herds of small stock and large stock, strategies found among more fully livestock-dependent pastoralists, such as the Borena in southern Ethiopia. In conclusion, I find this an original and innovative study that combines ecological, psychological, economic, and political factors important in understanding human behavior coping with risk and shocks, including drought, war, and global market forces.

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J. Terrence McCabe
Institute of Behavioral Science, University of Colorado, Boulder, Colorado 80309, USA (tmccabe@colorado.edu). 23 XI 15

I have experience with the cultivation systems of both enset and maize and with the concepts of resilience, adaptive cycles, and social-ecological systems. However, I do not have any experience with or knowledge of cognitive science, so my comments may not be as informed as others who have reviewed the paper. I found the idea of linking psychology, social-ecological systems, and cultural change intriguing but somewhat hard to follow. The authors argue that impulsive behavior is activated by social and economic shocks and that acting without thinking is activated to a greater degree in Sidama communities that are more dependent on maize. My first comment is, are the authors arguing for causation or correlation of particular psychological traits with different cultivation systems? I am not really sure what activating impulsiveness really means.

I think that it is interesting but not surprising that enset farmers are impacted less (as measured by careful control) by social shocks than maize farmers. The enset system has been preserved through many social shocks, while maize cultivation is relatively new. I also find the idea of acting without thinking a difficult and, at least to me, confusing concept to apply to Ethiopian farmers.

The authors mention the adaptive cycle and that the enset system is in the K phase of the adaptive cycle while the maize farmers are in the r phase, but they never really do anything with this. I think one could argue that the enset system is close—if not already in—the release or collapse phase, since the authors state that with population growth, among other things, the enset system is not sustainable. The authors mention that the success of enset depends on manure for fertilizer but do not discuss the dependence of the livestock system to access to common grazing and that these areas are being privatized and cultivated as population increases. This is important in that there is considerable risk to the viability of the enset system. Landholdings are also becoming smaller and may not be sufficient to supply a family with enough food for the year. Thus, this system could be in transition as well as the maize cultivation system.

I am also a bit confused by the issue of surprises, especially with those communities cultivating maize. Are the surprises crop failures? And if so, if they occur with some regularity, are they really surprises? I think it is also worth mentioning that development agencies, especially the United States Agency for International Development, have increasing maize cultivation in southern Ethiopia as one of their development priorities.

I like the idea that values, attitudes, and personality are not exogenous to the social-ecological system but are "part and parcel of the system" (Edgerton 1971:24). I believe this is an important contribution to the literature of social-ecological systems.

Brandon W. Ng and Shigehiro Oishi
Department of Psychology, University of Virginia, PO Box 400400, 485 McCormick Road, Charlottesville, Virginia 22904, USA (bwn7zb@virginia.edu). 13 XI 15

Bringing Socioecological Psychology to the Forefront: Dynamic Variation in the Relationship between Environmental Shock and Impulsivity as a Function of Subsistence Regime

Socioecological psychology is "an area within psychology that investigates how mind and behavior are shaped in part by their natural and social habitats (social ecology) and how natural and social habitats are in turn shaped partly by mind and behavior" (Oishi 2014:582). Although socioecological psychology is experiencing a resurgence, few studies have explored how specific, objective factors in one's physical or social environment may impact the mind and behavior, and vice versa (Ng, Morris, and Oishi 2013). Even fewer studies have explored socioecological variables outside of Western, educated, industrial, rich, democratic populations (Henrich, Heine, and Norenzayan 2010; for an exception, see Talhelm et al. 2014; Uskul, Kitayama, and Nisbett 2008). In light of these predominant issues, Quinlan et al.'s investigation is all the more impressive because they focus on the relationship between impulsivity and the agricultural practices of the Sidama, a severely understudied population. Specifically, they investigate how impulsivity may emerge as an adaptive psychological trait in response to environmental shocks and, more importantly, show that such emergence is moderated by socioecological context—in this case, enset versus maize farming.

As Quinlan et al. argue, enset is a stable crop that is relatively drought resistant and less susceptible to crop loss, though it also recovers slowly. Maize, conversely, is an unstable crop. It has a higher caloric yield and recovers more quickly than enset, but maize is also more dependent on rainfall and fertilizer price. In short, the world of enset farmers is relatively predictable: they can do what they have always done and expect the same returns. In contrast, for maize farmers, though maize promises the potential of more reward, it also entails increased risk, mandating heightened vigilance to environmental constraints. In this way, Quinlan et al. argue that impulsivity may be an adaptive trait in response to shocks in more unstable socioecological contexts. Indeed, while environmental shocks were relatively unrelated to impulsivity for enset farmers, for maize farmers, environmental shocks were associated with increases in impulsivity.

Quinlan et al. contribute immensely to research on self-control and the nature of impulsivity. Existing literature portrays the ability to exert self-control in an almost exclusively positive light. Self-control (which includes qualities like pondering one's actions carefully and delaying short-term gratification in light of more important goal pursuit) has been posited to be one of the most important qualities for a suc-

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cessful life (Mischel, Shoda, and Rodriguez 1989). Very few studies praise impulsivity, and it is normally understood as an unavoidable evil to be overcome. Quinlan et al., however, demonstrate that the nature of impulsivity may be more nuanced. Far from being a universal evil, it may be adaptive and beneficial in certain socioecological contexts.

That being said, the study does have limitations. Quinlan et al. assert that impulsivity is adaptive for cultural change. However, because the data presented were cross-sectional, taken at one point in time, we do not know for certain whether maize farmers' heightened impulsivity in response to shock actually leads to adaptive behaviors and better fit with their environment over time. Furthermore, selection bias is another concern as people self-selected to farm one form of crop over the other (thus, the observed differences could be due to factors other than the form of farming). Longitudinal data examining whether impulsivity is associated with future behaviors and outcomes—such as increased crop yields or greater feelings of certainty and cultural consonance—would be beneficial. Furthermore, because the reported data were all associative, longitudinal data would also lend credence to the causal nature of impulsivity in niche construction.

Second, Quinlan et al. mention an array of environmental shocks—such as rainfall variability, fertilizer price, drought, famine, and warfare—yet they operationalize environmental shocks only as the presence of crop loss and death or illness in the family. We encourage future research to assess the effects of different types of environmental shocks on impulsive behavior. For example, impulsivity may be adaptive in response to crop loss, so that maize farmers can focus on the immediate, bottom-up environmental constraints. However, in the case of warfare, it may be more adaptive for a person to carefully consider how to mobilize and protect one's social and economic resources from harm.

We also wonder if the rise in impulsivity for maize farmers in response to shocks represents a broad or more domain-specific phenomenon. For maize farmers, when an environmental shock occurs (e.g., a severe crop loss), would this induce farming-specific impulsivity (buying an immense amount of commercial fertilizer during a temporary drop in price), or would impulsivity increase for myriad self-regulation behaviors (caring for one's children or forgoing selfish impulses to help others in need)? If shocks increase general impulsivity, although it may be adaptive in the socioecologically relevant domain (maize farming), it may lead to detriments in other areas, which may lead to less adaptive behaviors overall. It is impossible from Quinlan et al.'s data to answer this question, for although they assessed their measures of impulsivity with relatively general items (e.g., "I am self-controlled"), these questions may have primed participants to think in a domain-specific way, if asked in conjunction with other items about farming. Future research should collect measures across time and include outcome measures that assess various domains (e.g., crop yield, subjective well-being), ideally including some behavioral measures of impulsivity. In addition, the adaptive nature of impulsivity in this particular context seems to lie in quick assessment of the situation and willingness to switch strategies. It might be more persuasive to test whether among maize farmers, environmental shocks predict sensitivity to negative cues and willingness to switch strategies in experimental games more strongly than among enset farmers.

Overall, Quinlan et al. lay the foundation for future work exploring socioecological variation in not only impulsivity but also an array of underlying personality factors. As they show, the relationship between environmental constraints (shock) and psychological traits (impulsivity) is not universal but rather culturally tuned to one's socioecological context. We hope that this investigation brings further research exploring the dynamics of socioecological context to fruition.

Reply

We are grateful for the comments we received. We agree with them all. They are a well-balanced set with two psychologically oriented comments and two ecological, precisely the translational position we sought. We set out to explore some ideas about relationships between environments and human thought for something like an ethnographic analysis. The comments pick up well where we left off. We address some of the larger issues that present challenges and opportunities for our approach. Our reply should not detract from other cogent comments, but space does not permit a point-by-point response.

Ng and Oishi wonder about responses to shocks other than crop loss and family death, especially warfare, and McCabe and Fratkin ask specifically about livestock loss. We chose the two most frequently reported shocks in our data set for analysis. Probability of having lost any livestock in the recent past ranges from 0.14 in Lokka Abaya (the highest) to 0.02 in Arbegona (the lowest), with a mean of 0.06. There are not enough Sidama data for multivariate analyses. In new research, Jilo Dira (2016) used free lists (Quinlan 2005) to explore perception of risks in two Sidama communities (table 5). Armed conflict appears low on the list for the most psychologically prominent risks in Boricha and was not among the top eight risks in Arbegona. Livestock loss appears among only the most salient risks in Arbegona. Note that baashe itself appears to be a salient concern in both Sidama communities.

Salience scores (table 5) show differences in risk perception in high-risk Boricha, where drought and food shortage are followed by much less salient risks, whereas diseases, land shortage, and money worries are nearly tied, followed by other moderately salient risks in relatively low-risk Arbegona. These results give some indication about local attention and cultural consensus (Ng and Oishi): tracing an imaginary scree plot from table 5, there appears to be more consensus about risk in K-cycle Arbegona than in r-cycle Boricha.

Ng and Oishi as well as McCabe raise concerns we share about the correlational nature of our data. We suspect that

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Table 5. Risk perception from 110 free lists in two Sidama woredas

Rank	Boricha risk	Salience	Arbegona risk	Salience
1	Food shortage	.75	Diseases	.74
2	Drought (rainfall failure)	.62	Land shortage	.70
3	Baashe	.12	Money shortage	.69
4	Diseases	.10	Death of cattle	.32
5	Armed conflict	.08	Food shortage	.26
6	Death of spouses/parents	.06	Baashe	.25
7	Hikes in food prices	.05	Crop loss	.24
8	Money shortage	.05	Delay in rainfall	.09

shocks cause impulsivity, but a longitudinal design is required to demonstrate the chain. Self-selection is a related problem, but here our analysis can cast some limited light. It is possible that impulsivity leads people to grow maize, but the evidence indicates no difference in impulsivity between maize and enset farmers except in response to shocks. Enset is rare in Hawassa Zuria, where it performs poorly, and it is almost universal in Arbegona, where it produces nearly as well as does maize in Hawassa Zuria (Quinlan et al. 2015), indicating that ecological factors are primary considerations for crop choice in some environments. Whether continuing to rely primarily on enset in mixed agricultural economies (Boricha and Lokka) is caused by psychological factors associated with impulsivity is unknown. If our results are partially explained by self-selection, then the mechanism involved is more likely psychological responsiveness or sensitivity to environmental shocks than impulsivity itself, an intriguing prospect suggesting links to developmental psychology (Ellis et al. 2011). A longitudinal design tracking changes in household condition in response to shocks (e.g., Hadley et al. 2011) might help sort this out.

Questions about the distinction between environmental predictability and harshness concern us and McCabe. At some point, if we understand him, crop loss could be so common it is predictable. We agree that there are solid theoretical grounds to distinguish environmental harshness and predictability (Ellis et al. 2009); however, we are less convinced of the ecological validity of the distinction. Knowing that crop loss occurs at a high rate is very different from knowing at planting in a specific year whether a crop will survive. Perhaps more importantly, from an investment standpoint, is whether risk is extrinsic—when outcomes cannot be changed much by planning or effort (Leslie and Winterhalder 2002; Quinlan 2007). Here Frankenhuis and Sheehy-Skeffington correctly identify links between our study and evolutionary models. Harshness and predictability may be so highly correlated that human psychological models treat them as a single environmental signal. This is an area of research where ecological anthropology, evolutionary ecology, and social-ecological psychology may fruitfully converge at some future point.

Activation for focusing attention is central to our argument in that we suspect there is substantial context dependence to what most psychologists perceive as stable phenotypic traits. We are not inclined, for purposes of culture theory, to theorize stable psychological traits until we have sorted out more about context-dependent states. In a simple model, activation is a perceptual process in which environmental stimulus triggers patterns of thinking similar to recalling a memory with the associated cascade of perception. For example, our mention of r and K terminology causes McCabe, given his prior experience, to reflect on integration of r and K in our analysis. The mental model is activated, and perception can proceed accordingly. For other readers with different prior experience, r and K may activate, evolutionary ecological models concerning fast and slow life histories (Figueredo et al. 2005). We found it a little surprising (unexpected) that McCabe found our analytical integration lacking for r and K sensu social-ecological systems. This point highlights difficulties of operationalizing social-ecological systems theory. We presented two cultural models of subsistence: one fast cycling, cross-scale dependent, and high risk; the other slow, relatively closed, and low risk. Then, we assess their relevance to patterns of self-perception about impulsive thought and action. We suspect that impulsivity promotes adaptive (useful, well-being enhancing) behavior in some conditions by generating new information for adaptive problem solving. Effects of impulsive self-perception on environmental exploration in observed behavior are unknown in non–Western, educated, industrial, rich, democratic populations (see Frankenhuis and Sheehy-Skeffington), but it may be a relevant question for development research. McCabe notes that our argument is sometimes hard to follow, and we agree that our integration of disparate concepts is coarse, but we think it is worth the effort to revisit a more psychologically oriented cultural ecology.

Frankenhuis and Sheehy-Skeffington as well as Ng and Oishi suggest room for more sophisticated psychology for cultural ecology. We agree. We are constrained, for now, by the nature of ethnographic fieldwork. One of our goals has been to identify short, simple psychological instruments that could be inserted (like a meme) into larger socioeconomic surveys for reliable and valid cross-cultural comparison. Useful options are few and far between, given the length and complexity of most standard instruments. Our prior experience translating common personality scales—even in Dominican English Creole—indicate potentially insurmountable methodological difficulties for cross-cultural comparison using certain scales. In contrast, the Barratt impulsiveness scale shows some cross-cultural valid-

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ity at least for tiny and narrow factors, as McCabe notes. Hence, our operationalization of impulsivity is constrained to six items. Quasi-experimental methods would be most welcomed, perhaps using hypothetical framing, if they can be incorporated easily in broader development research.

On a related issue, Ng and Oishi wonder, rightly we think, about priming effects in our self-report data. The survey was split into two parts: (1) we first administered an individual questionnaire covering basic person characteristics, fertility history, marriage, and so on, including impulsivity items; (2) a household interview followed the individual interview, concerning household economics, shocks, and so on.

Like Frankenhuis and Sheehy-Skeffington, we are also concerned that at times culture allows us to act without much reflection, and this may prove to be a fatal flaw in our reasoning. The point is that cultural models are, theoretically, only one set of internal representations on which perception acts. Impulsivity offers the possibility that we might shut up certain models and still think adaptively. Is impulsivity the right mechanism? Probably not by itself, but this is our starting point for integrative theory for culture and ecological change. We suspect that more attention to bidirectional predictive processing may suggest mechanisms for cultural (local and integrated) adaptation.

Fratkin understands our argument and evidence. His comments reflect our conversations with him concerning this research, and we are especially grateful for that.

—Robert J. Quinlan, Samuel Jilo Dira, Mark Caudell, and Marsha B. Quinlan

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