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Objectivity as standardization in data-scientific education policy, technology and governance

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Abstract New data-driven technologies appear to promise a new era of accuracy and objectivity in scientifically-informed educational policy and governance. The data-scientific objectivity sought by education policy, however, is the result of practices of standardization and quantification deployed to settle controversies about the definition and measurement of human qualities by rendering them as categories and numbers. Focusing on the emerging policy agenda of 'social and emotional learning and skills,' this paper examines the practices of 'objectivity-making' underpinning this new field. Objectivity-making depends on three translations of (1) scientific expertise into standardized and enumerable definitions, (2) standardization into measurement technologies, and (3) the data produced through measurement technologies into objective policy-relevant knowledge, which consolidates a market in SEL technologies. The paper sheds light on knowledge-making practices in the era of big data and policy science, and their enduring reliance on the precarious construction of objectivity as a key legitimator of policy-relevant scientific knowledge and 'evidence-based' education governance.

Keywords *data, objectivity, policy, psychology, social-emotional learning and skills, standardization*

The rise of digital data analytics has catalysed attempts to render ever-more 'objective' measures of education. New forms of data-driven analysis performed through education technologies appear to promise a new era of accuracy and objectivity in scientifically-informed educational policymaking. The production of data about students represent attempts to capture students in increasingly objective fidelity. In so doing, these scientifically-produced measures may become increasingly influential in directing policymakers toward problems for intervention,

as they produce ‘policy-relevant knowledge’ with the ‘objectivity,’ neutrality and impartiality ascribed to the authority of pure science itself (Jasanoff 2011). While objectivity is at the centre of scientific modes of data-driven ‘evidence-based policy’ (Webb & Gulson 2015), however, objectivity is itself produced through processes that involve networks of actors, technologies, policy activity, and scientific expertise—revealing how the objectivity of a data-scientific form of education policy is in fact a precarious achievement.

The paper analyzes how objectivity is ascribed to datafication in education through an analysis of emerging measurement technologies designed to capture data about students’ ‘social-emotional learning and skills’ (SEL). In recent years, SEL and related categories such as ‘soft skills’, ‘character education’, and ‘noncognitive learning’ have become the focus for governments, education technology vendors, think tanks, psychologists, economists, psychometricians, and influential international organizations (Bates 2017; Bull & Allen 2018; Duckworth & Yeager 2015). We focus primarily on three organizations involved in promoting SEL: the Organisation of Economic Cooperation and Development (OECD), the Collaborative for Academic, Social and Emotional Learning (CASEL), and the World Economic Forum (WEF), plus related educational technology vendors and partners. Together, these organizations are creating a collective field, or a ‘policy community’, dedicated to a new psychological science of learning, practice, measurement, and policy influence (Allen & Bull 2018). As the co-founder of CASEL puts it:

‘we need new science, we need new training, we need new standards of implementation, new policies ... [and] new tools to measure its effectiveness. ... When you get all those things put together, that’s a field. That’s a new field with new programs and practices, new policies, and new ways of engaging the community’. (Aspen Institute 2017: 17)

By tracing the creation of this new field of SEL science, implementation, measurement, and policy influence, we identify three key translations in the production of objectivity: (1) how SEL has been defined and standardized for enumeration through translating psychometrics and economics expertise into measurable categories; (2) how these standardized categories have then been translated into the design of particular measurement technologies which are intended to make SELs legible as objective data; and (3) how, through the production of ever-finer objective data, organizations that promote SEL are seeking to produce scientific knowledge that might be translated into policy

influence, and that this is further opening up a marketplace for technology providers that can capture psychological attributes as quantitative data.

Analytically, we focus on standardization as a prerequisite to objectivity, and trace the production of standardization and objectivity in the emerging SEL field. As Jasanoff (2011) has detailed, ‘objectivity-making’ for policy takes hard work. It is procedurally produced, performed and reproduced in culturally situated settings by actors and institutions working within and in between the contested environments of science and policymaking. In other words, considerable practical work takes place in the translation of science into policy objectivity. In this paper we are interested in the knowledge work, quantitative practices, and technical developments involved in establishing the objectivity of policy-relevant scientific knowledge about SEL. It exemplifies problematic claims made about objectivity in relation to digital datafication in education, and reveals new ways in which data are being made as part of educational policy developments that focus on instrumentalist ‘what works’ programs and ‘evidence-based policymaking’. As such, our examination of SEL provides a critical perspective on the ‘objectivity’ of contemporary and emerging data-scientific modes of education policy, in particular by focusing on some key policy actors, forms of scientific expertise, metrics, and data-processing technologies through which objectivity is produced and circulated.

Methodologically, we examine materials produced to promote SEL technologies, analysing them for their scientific claims to objectivity, and relevant policy documentation and policy lobbying materials where these technologies are advocated, plus published scientific literature mobilized by advocates to support these technologies. Through analyses of how psychological data are produced as objective policy-relevant knowledge, our main claim is that SELS, as a contested science-in-the-making, embodies attempts by policy influencers to stabilize the field through the production of objectivity, while broadening and consolidating the uses of education technology.

Data-scientific policy objectivity

Data have become central to practices of educational policymaking at local, national and global scales (Anagnostopoulos et al 2013; Sellar & Lingard 2014). Research has begun to show how the collection, processing and dissemination of digital educational data relies on dynamic sociotechnical networks of people, policies and technologies which together produce new ways of measuring, evaluating, and governing education (Piattoeva 2015; Hartong 2016; Sellar 2017;

Williamson 2017). As such, data-scientific practices that utilize advanced technologies and scientific methods of data collection and analysis are emerging as sources of policy-relevant knowledge and policy objectivity (Sanders et al 2017). At the same time, new 'policy science' approaches have developed whereby behavioural, psychological and neurological insights have been deployed in education (McGimpsey, Bradbury & Santori 2016). Although science has long been integral to education policy, based on techno-rationalistic assumptions that policy problems can be resolved through specialist expertise and methods (Webb & Gulson 2015), the emerging field of social-emotional learning and skills exemplifies the combination of data science and psychological science as novel sources of policy knowledge, with objectivity ascribed to the datafication of students' psychological traits, characteristics and attributes.

Translating science into policy objectivity is a complex practical accomplishment, not least since scientific objectivity itself is a social achievement (Jasanoff 2004). Critical studies of psychology, for example, have revealed how its disciplinary objectivity is produced through clinical examinations, experimental procedures, demonstrations, authoritative explanations, the production of texts, tables, diagrams and images, and the rhetorical deployment of evidence (Rose 1999). Psychometrics, or the field of psychological measurement, in particular, has been singled out as a field in which the central assumption that psychological attributes such as personality traits and cognitive abilities are quantitative and objectively measurable often remains unquestioned (Michell 2008). According to such studies, the objectivity of psycho-realist accounts of the quantitative 'facts' of human psychology is in fact a complex expert accomplishment involving concrete materials and practices, undertaken in particular settings, according to disciplinary conventions, agreements and decisions regarding psychological measurement.

The objectivity-making of science has long been the subject of Science and Technology Studies (STS), which we can only briefly touch on here. In particular, STS has focused on examining the practices that produce 'objective' representations of nature. It has emphasized the meticulous work invested into making 'facts' credible as a transcendent mirror of reality, the emergence and stabilization of new objects of inquiry as a precarious achievement, and the intelligibility and portability of the products of science (Jasanoff 2004). As noted by Daston (1992: 600), objectivity in its normative sense of abstaining from perspective emerged 'when science came to consist in large part of communications that crossed boundaries of nationality, training and skill'. In the

context of practical scaling up of both science makers and science audiences, objectivity started to function to bring disparate sites and actors into relations (Porter 1994), thereby creating ‘spaces of objectivity’ such as expert agencies, commissions, and forums for expert presentations (Fourcade 2018).

Particularly, quantification came to be allied with objectivity not because it mirrored reality more accurately, but because numbers were easily transportable (Desrosieres 2001). Numbers may be shared across disciplinary divides and cultural borderlines, enabling effective communication between parties whose goals, interests and beliefs may be otherwise different (Porter 1994). In the case of ‘regulatory science’ created to serve policy needs, the requirement of the communicability of knowledge is even more acute because such knowledge is vulnerable to criticism and unfolds under adversarial conditions (Jasanoff 2011). The demonstration of objectivity lends cognitive authority to and empowers those who can claim it (Megill 2007). In this process, not only is the science rendered truly objective as knowledge, but the potential interpretive flexibility of the available knowledge is temporarily resolved as policy influencers work to translate and fix it into policy.

Objectivity-making in this sense is underpinned by processes of standardization. Porter (1994) argues that tools of standardization enable something that started as local and situated to be made public and replicable across space and experience, thereby intensifying the production and diffusion of standardized recording and analytical instruments that are based on agreed upon scientific categories. The notion of *procedural* objectivity highlights the role of impersonal, standardized methods of investigation (Megill 1994). Procedural objectivity posits that human quality is problematic, and the solution to this problem rests on both the multiplication of measurements and points of view across different sites and the meticulous standardization and stabilization of the processes and environments of quantification (Daston 1992; Piattoeva & Saari, forthcoming). An independent, standardized experimental apparatus that is detached from its user/observer needs to be created in order for it to render identical results across spaces (Porter 1994). Standardized analytical categories are the precondition for building standardized measurement tools that help to render uniform results, thus proving the theory that underlies the endeavour in the first place.

Claims of the objectivity of science necessitate ‘arriving at criteria for judging claims to have represented things as they really are’ (Megill, 1994: 2). This ambition

represents the *disciplinary* aspect of objectivity, captured in the notions of trained eye, consensus, shared norms and control of self (Jasanoff, 2011, Daston 1992, Porter 1995). As Megill (1994: 1) writes, a disciplinary sense of objectivity ‘takes consensus among the members of particular research communities as its standard of objectivity’. The calibration of instruments required for the replication of scientific facts leads to the centrality of standardized skill and vision achieved through meticulous socialization (Megill 2007). At the same time, non-scientists are equally in need of and become the targets of standardization and consensus-making, especially when science seeks to extend to policy decision-making and the commercial arena.

The above discussion illustrates how the practices of standardization are ingrained into and seem indispensable to objectivity-making. Standardization is thus equally a process of stabilization in which the object to be known, and the knower, get manufactured. As Megill (1994) expands, standardization as a practice of objectivity-making impacts both objects and subjects. The former is captured and standardized through the construction of rigid measurement tools, while rule making standardizes subjects by limiting their room for personal judgement. In the following we show how the hard work of objectivity-making unfolds through practices of standardization. These practices attempt to stabilize both the objects and subjects of SELS and prove to be extremely productive for further expansion of education technology markets. In the following sections we illuminate how objectivity-making in the new field of SEL is being accomplished through the three translations of (1) scientific expertise into standardized and enumerable definitions and categories, (2) standardization into measurement technologies, and (3) the data produced through measurement technologies into objective policy-relevant knowledge, which consolidates a market in SEL technologies. Through these overlapping practices, SEL has been made legible as categories and numbers, made amenable to calculation, and processed into objective data for use in a new policy science of student emotions.

Psychometric science and SELS standardization

The first way in which data about social-emotional learning and skills is produced as objective policy-relevant knowledge is the production of standardized SEL definitions from existing science expertise, in ways which make SEL amenable to enumeration as objects of measurement. This key process of translation of expertise into standards is exemplified by the OECD’s recent announcement of a new Study on Social and Emotional Skills (SSES,

<http://www.oecd.org/education/cei/thestudyonsocialandemotionalskills.htm>), part of the OECD's growing portfolio of international large-scale assessment instruments (OECD 2017). SSES will consist of a computer-based test to be taken by 10 and 15 year-olds. Scheduled for launch as a trial version in 2018, SSES will roll out in 2019 with first results due 2020. The purpose of the survey is to 'provide participating cities and countries with robust and reliable information on the social and emotional skills of their students,' and also to 'have policy relevance' by identifying 'the policies, practices and other conditions that help or hinder the development of these critical skills.' As a 'policy-relevant project,' the OECD claims, 'study findings can also be used by policy makers to devise better policy instruments geared towards promoting these types of skills in students' (<http://www.oecd.org/education/cei/study-on-social-and-emotional-skills-faq.htm>).

Behind the OECD SSES survey and its objectivity and policy relevance lies a body of expert knowledge about the measurable qualities and characteristics of socio-emotional skills. The study is being administered by an international consortium led by the Center for Human Resource Research (CHRR) at The Ohio State University in Columbus, Ohio, USA (<https://chrr.osu.edu/>). The CHRR's mission is to provide 'substantive analyses of economic, social, and psychological aspects of individual labor market behavior to examining the impact of government programs and policies.' According to the CHRR, the SSES project will identify 'those social and emotional skills that are cross-cultural, malleable, measurable, and that contribute to the success and well-being of both the youth and their society' (<https://chrr.osu.edu/projects>). As such, the project is centrally concerned with defining and categorizing SEL skills, with the creation of a set of standards for their classification and categorization, and with making the noncognitive aspects of learning enumerable, measurable and calculable.

Importantly, from the perspective of the standardization practices required to produce policy-relevant objectivity, the OECD claims socio-emotional skills constructs can be classified into five broad categories—thereby furthering standardizing SEL as objects to be known and enumerated. It refers to as a well-known framework called the 'Big Five model': emotional regulation (emotional stability); engaging with others (extraversion); collaboration (agreeableness); task performance (conscientiousness); open-mindedness (openness)' (OECD 2017: 5). These Big Five categories derive from psychological theory and research conducted over the last three decades which has produced a five factor model of

personality consisting of openness, conscientiousness, extraversion, agreeableness and neuroticism (OCEAN). Psychologists have developed standardized tests and assessments, including the Big Five Inventory (BFI), the Neuroticism-Extraversion-Openness Personality Inventory (NEO-PI) the International Personality Item Pool (IPIP) and Trait Descriptive Adjectives (TDA), to measure these personality traits (Soto & John 2017). Indeed, the original architect of the BFI, the psychologist Oliver John of the Berkeley University Personality Lab, was a key informant in the development of the OECD's framework for SSES (OECD 2015). As a consequence, the OECD's categories map exactly on to the five factor personality categories, assuming that these psychological traits are quantitative—an assumption Michell (2008) describes as the 'pathology' of psychometrics.

Indeed, as with most psychometrics, the OECD refers to a huge body of quantitative psychometrics literature to justify its approach to personality measurement. A 2017 working paper published by the OECD, entitled 'Personality matters: Relevance and assessment of personality characteristics', provided a scientific literature view on a range of personality characteristics and ways of measuring them. Its author noted that 'personality characteristics have a demonstrable relevance for a wide range of policy issues and represent an important, although often neglected, subject of policy interest' (Kankaras 2017: 4). Crucially, the review notes strong correlations between high scores in the Big Five and other outcomes such as academic achievement, job performance, and standardized test scores, and details the Big Five inventories available to measure students' socio-emotional skills in a standardized way. As this indicates, with SSES the OECD intends to apply the standardized OCEAN categories to the quantitative measurement of students' socio-emotional skills in order to derive objective policy-relevant insights into effective interventions that improve these skills. Notably, the report emphasizes the 'policy relevance' of the insight that many personality characteristics—or socio-emotional skills as the SSES translates them—are malleable and can therefore become a 'potential target for policy intervention' (Kankaras 2017: 82). Psychometric categorization and quantification is therefore an essential step in translating personality science into a policy science.

However, the OECD's categorization, standardization and enumeration of SEL relies not just on scientific expertise in psychometric quantification, but on the translation of personality theory into economic modes of calculation. As with its cognitive skills assessment PISA, in which test results are treated as surrogate measures of 'human capital' (Sellar & Lingard 2014), the OECD's SSES instrument

is invested with economic imperatives, not just psychological theories. In its previous Skills for Social Progress report, the OECD noted that ‘skills are broadly defined as individual characteristics that drive at least one dimension of individual well-being and socio-economic progress (productivity), that can be measured meaningfully (measurability), and that are malleable through environmental changes and investments (malleability)’ (OECD 2015: 34). It added that social and emotional skills are ‘a) individual capacities that are manifested in consistent patterns of thoughts feelings and behaviours; b) can be developed through formal and informal learning experiences and c) influence important socioeconomic outcomes throughout the individual’s life’ (OECD 2015: 34). Again, the OECD has worked hard to stabilize a series of slippery concepts into a standard vocabulary and set of explanation that make SELS appear commensurate with economic outcomes—thereby making it possible to calculate socio-emotional skills as measurable indicators and predictors of socio-economic outcomes, and ultimately translating students’ social-emotional learning into performance metrics to compare different nations’ production of human capital.

The accomplishment of the OECD in attaching emotional categorization to economic calculation has required significant external expertise and policy advice. The OECD’s approach to the economics of SEL is directly informed by James Heckman, the Nobel Laureate in economics whose ‘Heckman equation’ has become a powerful way of calculating the economic gains to be returned from investment in childhood programs. Based on extensive econometric analysis applied to aspects of developmental psychology, personality theory, and ‘human capability formation,’ Heckman has argued that ‘socioemotional skills, physical and mental health, perseverance, attention, motivation, and self confidence’ are all ‘important determinants of socioeconomic success, ... contribute to performance in society at large and even help determine scores on the tests that are used to monitor cognitive achievement’ (Heckman 2008: 3-4). The analysis he presents leads to the conclusion that ‘personality factors are also powerfully predictive of socioeconomic success and are as powerful as cognitive abilities in producing many adult outcomes’ (Heckman 2008: 5).

Heckman’s work is significant because it directly fuses policy and science, while showing how SEL objectivity borrows authority from earlier approved scientific claims. He claims that ‘capabilities are produced by investment, environment and genes’ and that ‘capability formation process is governed by a multistage technology’ whereby ‘inputs or investments at each stage produce outputs at the

next stage' (Heckman 2008: 33). Heckman's advocacy for 'personality investments' and the effects of noncognitive skills on human capital and labour market outcomes have been influential in the OECD's Education and Social Progress program (of which SSES is a major instrument). Drawing on findings previously published in Heckman and Kautz (2013), Heckman co-authored the 2014 OECD paper *Fostering and Measuring Skills: Improving cognitive and non-cognitive skills to promote lifetime success* (Kautz et al 2014). It highlighted that 'IQ tests and achievement tests do not adequately capture non-cognitive skills, personality traits, goals, character, motivations, and preferences that are valued in the labour market, in school, and in many other domains' (Kautz et al 2014: 7). Strikingly, in reviewing programmes to support noncognitive skills, the authors claimed that 'Some have annual rates of return that are comparable to those from investments in the stock market' (Kautz et al 2014: 8). These arguments establish authority by criticising the inability of earlier studies to capture the human being in her entirety, that is, to enable an objective representation of reality 'as it is'. Such claims also borrow credibility from and connect to economics theory, predictive economics modelling and statistical analyses based on reliable, objective measures of non-cognitive skills.

As these points illustrate, SSES comes preloaded with economic priorities around productivity maximization, with 'individual capacities' treated as influences on wider socioeconomic outcomes. The malleability of socio-emotional skills is presented as imperative to improving socio-economic progress. The policy relevance of this equation relies on the objectivity of standardized personality testing as claimed by psychologists and psychometricians, as well as standardized econometric methods for predicting productivity outcomes from personality measurement. However, the use of self-report surveys for capturing noncognitive skills has been questioned by psychologists within the field of educational assessment and measurement (Duckor 2017), while influential figures such as Duckworth have questioned the validity of instruments to capture adequate empirical measures of their constructs (Dahl 2016). Wilbrink (2016), moreover, argues that OECD reports based on fusing personality psychology with econometric analysis 'lack scientific grounding,' exemplifying ongoing contests over the objectivity ascribed to SELS science by its most active advocates. As with mainstream psychometrics, the SSES survey is underpinned by the assumption that psychological traits such as personality are quantitative (Michell 2008), twinned with the belief in mainstream economics that 'economic reality' can be known 'through measurement and measurement only' (Fourcade 2018). These forms of 'metric realism' (Desrosieres 2001) obscure all the hard work, disciplinary practices

and choices made in translating complex psychological traits and economic knowledge into standardized categories. These practices of objectivity-making depend on the formation of a disciplined consensus among practitioners who have converged upon agreed standards and procedures (Megill 2007). As such, the first stage in rendering SEL as an objective, quantitative science, as the OECD example demonstrates, is the consensual creation of standardized, enumerable categories for both psychological and economic measurement, which then provide the basis for the design of measurement technologies such as the SSES survey.

Designing measurement technologies

The second key translation of SEL into policy-relevant science knowledge is the mobilization of standards into concrete technologies of measurement. The OECD's computer-based SSES survey is one such example—as the Big 5 are put to the task of large-scale student assessment—but CASEL has also played a significant role in proceduralizing SELS knowledge through measurement technologies. CASEL has actively sought to shape how educational technologies are designed to promote SELS through a 'design challenge' on 'innovative direct assessments of social-emotional skills' (McKown, Read & Bookman 2017), the aim of which is 'to shine a light on innovative and technically sound direct assessments of SE competencies that are also practical and feasible to use in schools, and in so doing to stimulate further development and adoption of these assessments' (McKown & Trejo 2018). Notably, the internal evaluation of the design challenge noted the need for more fully-defined 'design principles' 'to clarify which of those features is most important for an SEL assessment,' and clearly communicate 'what is being measured and how that thing is related to the reality of classroom life and the broader SEL movement' (McKown et al 2017: 4). These ultimately represent standardized design principles for future SEL technologies, supported by appeals to the 'reality' of classrooms and a homogenized account of the SEL movement.

CASEL is an ideal illustration of the meticulous and hard work involved in translating science into consensus for objective measurement technologies. Scientific literature collected in meta-analyses by CASEL demonstrates how the objectivity of SEL technologies is promoted through the translation of science into standards and quantitative measures. CASEL's first meta-analysis was originally published in 2011 in the journal *Child Development* (Durlak et al 2011) with a follow up in the same publication in 2017 (Taylor et al 2017), both of them reporting findings as objective facts:

Current findings document that SEL programs yielded significant positive effects on targeted social-emotional competencies and attitudes about self, others, and school. They also enhanced students' behavioral adjustment in the form of increased prosocial behaviors and reduced conduct and internalizing problems, and improved academic performance on achievement tests and grades. (Durlak et al 2011: 13)

It is notable that the 2017 meta-analysis mobilizes a standardized framework called 'Positive Youth Development (PYD) which 'focuses on enhancing young people's strengths, establishing engaging and supportive contexts, and providing opportunities for bidirectional, constructive youth-context interactions' (Taylor et al 2017: 1156). The empirical and theoretical bases for PYD, the authors note, are the '5Cs' framework developed by Lerner (2005: 2) in a white paper on the science of adolescent health and development:

[PYD] has arisen because of interest among developmental scientists in using developmental systems, or dynamic, models of human behavior and development for understanding the plasticity of human development and, as well, the importance of relations between individuals and their real world ecological settings as the bases of variation in the course of human development.

The standardized categories of the '5Cs' of PYD refer to 'Competence, Confidence, Connection, Character, and Caring' (Lerner 2005: 31). Although the 5Cs of PYD constitute part of the framework for CASEL's meta-analysis, CASEL itself has not straightforwardly adopted the 5Cs. Instead, CASEL emphasizes an alternative set of five competencies which constitute SELS: self-awareness; self-management; social awareness; relationship skills; and responsible decision-making. The meanings of these categories overlap to some extent—'confidence' in the 5Cs appears similar to 'self-awareness' in CASEL's framework, while 'connection' and 'caring' link, respectively with 'relationship skills' and 'responsible decision-making.' CASEL emphasizes 'skills' more strongly than PYD. These definitional slippages and translations clearly reveal how SEL, as a science-in-the-making rather than a homogenous movement, remains a site in which competing categories are being put forward as standardized systems for measuring objectively the non-cognitive aspects of learning.

Based on these translations, CASEL has actively employed its categorical standards in quantitative technologies of SEL measurement. It has both produced a State Scan Scorecard (<https://casel.org/state-scan-scorecard-project/>) to measure different US states' progress on developing students' social-emotional learning—part of its proposal to use SELS as a school accountability measurement (West

2016)—and has used its Design Challenge to provide standardized rules for the production of SELS technologies. In two iterations of the Design Challenge, it has sought to refine its standardized guidance for SEL ‘competence assessment services’ (McKown & Trejo 2018). CASEL is seeking to subject SEL to standardization and datafication by imposing its framework and its guidance on the emerging field of SELS technology development. Like the OECD, CASEL has also committed to the production of glossy brochures and reports summarising the scientific knowledge base on SEL. In these ways, these organizations are seeking to produce authoritative policy-relevant knowledge and standardized criteria for its production, performing what Jasanoff (2011: 4) terms ‘the added work of representation and persuasion that actors must do to project credibility, objectivity and truth to non-scientific audiences.’ In so doing, CASEL and the OECD are building consensus for the idea that SEL is quantitatively measurable as standardized categories which act as proxies for complex psychological traits, emotional states and characteristics, and are building or promoting technologies for their measurement. Furthermore they are catalysing demand for SEL assessment services and other technologies to capture students’ socio-emotional learning as digital data.

Objective data-scientific policy & market-making

The third key translation of SEL into a policy science concerns the production of ever-finer precision and objectivity through technologies that can process ‘big data’, and the opening up of a market of innovative products to capture SEL data in classrooms. Such technologies fuse the objectivity ascribed to SEL to practice in classrooms, acting as sociotechnical diffusers of standardized psychological vocabularies and practical relays of economic metrics from the expert realm to spaces of enactment. As CASEL itself has noted, existing SEL ‘competence assessments currently offered in the commercial marketplace include self-report questionnaires, teacher rating scales, direct assessments, and peer nomination measures’, and notes that future iterations of its Design Challenge might focus on ‘soliciting ideas for how different sources of assessment data can be collected and combined to provide a richer picture of student strengths and needs than would be possible with a single source of data’ (McKown & Trejo 2018). A commercial marketplace of digital, data-processing technologies to support SEL has already emerged for ‘affective capture’ in classrooms (Nemorin 2017; Hogan et al 2018). As such, the further translation of SEL from standards for quantitative measurement into specific technologies, and from there into policy and practice, depends on building a rich marketplace of providers of technologies that can

capture increasing quantities of data and process it into objective policy-relevant knowledge that meets practitioners' needs.

While the OECD exemplifies the use of psychometric survey techniques in the measurement of SEL, and CASEL exemplifies the expansion of datafication techniques, newer psychoinformatic innovations using 'big data' have also been developed and advocated for capturing SEL data. These technologies expand the enumerative capture of SEL data from the sample survey of SSES and the metadata of CASEL's Design Challenge to automated real-time analytics, bringing with them the big data promise of impartial objectivity. The emerging field of psycho-informatics is based on the application of computer science techniques to psychological tracking, measurement, and analysis of behaviours, emotions, personality traits, attitudes, cognition, and abilities (Markowitz et al 2014). It employs a combination of behavioural data sources such as wearable sensors to track movements; smartphones to trace online activities; big data stores for psychological analysis; and analytics platforms that use techniques from data mining and machine learning to detect, characterize, and classify behavioural patterns (Markowitz et al 2014).

Psycho-informatics stand poised for entry into education and the enhanced quantification of SEL through the advocacy of the World Economic Forum. The WEF promotes the ideal that digital technologies could be used to measure and build 'character qualities' and that SEL proficiency will equip students to succeed in a swiftly evolving digital economy (WEF 2016). In particular, it emphasizes the use of wearable biometric devices and facial vision systems as technologies to capture indicators of social-emotional learning from the bodies and faces of students in real time. As such, WEF's endorsement of psycho-informatic and biometric technologies represents a shift from the more conventional computer-based psychometric testing of the OECD's SSES or CASEL's data-processing SEL technologies, to a real-time, automated, psycho-informatic approach to measuring SEL—and requires the involvement of commercial vendors claiming highly standardized data-scientific ways of producing objective results.

Two biometric examples are provided in the WEF report: the wearable wristband Empatica, and the facial vision system Affectiva (both originating in the MIT Media Lab but spun out as commercial enterprises), claimed by WEF to promote SEL. It suggests these 'affective computing' innovations will allow systems to recognize, interpret and simulate human emotions, using wearable biometric

devices, webcams, eye-tracking, databases of expressions and algorithms to capture, identify and analyse human emotions and reactions to external stimuli, and to differentiate between emotions such as happiness, fear, surprise and confusion (WEF 2016). Empatica is a wrist-worn device designed to measure emotionally aroused responses such as stress and anxiety, and then vibrate to nudge its user ‘to switch to a more positive response’ (<https://www.empatica.com/>). These biometric bracelets run an electric current across the skin to measure changes in electric charge as the sympathetic nervous system responds to stimuli, and detect emotional responses such as excitement, stress, fear, engagement, boredom and relaxation through the skin. Affectiva claims it ‘pioneers in emotion recognition software’ and ‘Emotion AI,’ having developed a ‘science platform using deep learning and the world’s largest emotion database’ (<https://www.affectiva.com/>). Its database includes nearly 6 million images and videos of human faces scraped from the web, which Affectiva has analysed and tagged using its Affdex ‘emotion classifier’ service to produce ‘emotion metrics’ on each image (Affdex, no date). The service then compares each pixel of facial data from new users with its tagged dataset to classify the precise emotional response associated with their facial movements. Data scientists working at Affectiva itself have claimed that ‘as distance learning becomes more popular automated measurement of learners’ emotional states becomes more critical’ (McDuff et al 2016).

The WEF’s endorsement of biometric and affective technologies relies on the production of objective, standardized scientific knowledge pertaining to the measurement of emotions from embodied signals. Rather than relying on student self-reporting at long periodic intervals, as in the OECD SSES, in the WEF vision, the body is treated as quantifiable through emotion metrics that track signals in real time. The emotion analytics performed by Affectiva has been described by D’Mello (2017) as ‘affect detection from bodily signals’, whereby embodied affects are understood to be ‘machine-readable’ as observable signals. The automated detection of affect from embodied signals is enabled by video recordings, ‘computer vision programs’ and ‘motion filtering algorithms’ which can identify ‘facial action units,’ head pose and body movement and correlate these observable signals to an underlying emotion classification model, using machine learning methods to ‘build detectors of each affective state’ (D’Mello 2017: 118).

Significant effort has been invested to produce the standardized categories and measurement instruments that derive objective knowledge about human emotions from bodily signals. Systems for affect detection from bodily signals such as

Empatica and Affectiva rely on standardized emotional classification scales such as PANAS (Positive and Negative Affect Scale), twinned with Facial Action Coding Systems (FACS) that correlate facial movements with emotional categories, and psychophysiological analytics that match biological signals to affective states. These classifications of the emotions crucially need to be understood as part of the hard work of objectivity-making through the creation of standardized classification systems. First originating in the 1970s through psychological efforts to classify human emotion into distinct categories, PANAS and FACS have evolved from paper-based self-report surveys and observation schedules for use in laboratory settings to automated systems that correlate biological signals to their emotional explanation (Rose et al 2015). Some of the key work in this area by the psychologist Paul Ekman posits that particular facial behaviours and micro-expressions are universally associated with particular emotions of happiness, sadness, disgust, surprise, anger, and fear (Ekman & Friesen 1976; Ekman 2016). The Affdex emotion classifier service underpinning Affectiva is directly built on Ekman's FACS, which its data scientists describe as 'the most comprehensive and widely used objective taxonomy for coding facial behavior' (McDuff et al 2016). Based on this 'objective taxonomy' it uses an automated version of FACS 'trained' on millions of labelled and tagged facial images to identify emotional valence, attention and expressiveness. Through the development of these specific scientific practices, facial actions and emotions have been standardized for capture as data, enabling the subjective aspects of human experience to be rendered as machine-readable, objective, quantitative measures. The numbers so produced then serve as detached realist metrics of emotional arousal.

All psychometric and psycho-informatic instruments for objective quantitative measurement of emotion depend on specific standardized psychological theories, categories and scales, which possess their own procedural and disciplinary objectivity as products of specific practices undertaken through the consensus of expert communities of practice. The efforts of organizations such as the OECD, CASEL, and WEF to stabilize SEL for objective measurement and accurate intervention is now stimulating increased user demand from practitioners, and catalysing a fast-growing market of providers of SEL apps, data analytics, and assessment platforms (Hogan et al 2018; Nemorin 2017). Body-worn analytics and biometrics, informed by the psycho-informatic turn to real-time data in psychometrics, represent an attempt to ascribe objectivity to automated systems that can read the body directly for signals without the subjective 'noise' associated with self-report surveys. These technological innovations, as their endorsement by

the WEF demonstrates, are being positioned as ideal instruments for data-scientific policies which depend on objective knowledge about the psychological correlates of education and learning. Their uptake in a market of SEL products and services is essential to the formation of the social-emotional ‘big data’ required by authorities to understand the emotional aspects of student learning, and to build momentum for further policy intervention (Aspen Institute 2018). As such, the translation of psychological and economic expertise into a new ‘policy science’ of SEL unfolds in parallel with, and is dependent upon, an expanding market of SEL measurement technologies.

Conclusion

In this paper we have explored how the objectivity ascribed to datafication is actively produced through processes of standardization, enumeration, and technical innovation in big data technologies, through the particular example of social-emotional learning and skills. As a new field of science, measurement, and technical development, SEL advocacy organizations are seeking to secure consensus for the key claim that the noncognitive aspects of education are quantitative and measurable, as well as malleable and open to being improved through policy intervention. The objects of SEL, in the shape of psychological traits and characteristics, are stabilized as standardized and enumerable categories that can be transported to new sites of practice and coded into new assessment services, metrics, and technology products. The procedural objectivity of SEL has been accomplished through impartial modes of investigation based on agreed scientific categories. At the same time the subjects of SEL—its scientific supporters, practitioners, and policymakers—are also standardized as disciplinary consensus across the field closes down room for subjective personal judgment.

The processes of standardization documented in this article reveal how different knowledges and practices—such as personality theory, positive youth development, and facial action coding—are being made public and replicable by organizations such as the OECD, CASEL and WEF, and thereby driving demand and stimulating a new market in SEL-based educational technologies, while also producing policy-relevant knowledge. As an emerging global policy community, these organizations are establishing a new frontier for data-scientific education policy, while empowering themselves as key sources in the procedural production of objective policy knowledge, and positioning themselves as expert spaces of objectivity. Objectivity is especially powerful to education policy because it represents a claim to authority that seems to ‘mirror reality without distortion and

hence is not contestable’, though, while it is ‘easy to claim,’ it is ‘hard to accomplish “in practice”’:

Policy objectivity, like all social norms, is painstakingly constructed, contested, reaffirmed and performed in the routine practices of social actors and institutions. ... [T]hese modes of construction and affirmation become most visible at moments of controversy, when opposing actors challenge each other’s assumptions and so reveal the interpretive flexibility of concepts such as objectivity. (Jasanoff 2011: 21)

The claims to objectivity focus on expelling or subordinating subjectivity. Specifically, objectivity is employed as a controversy-settling mechanism as it is established through processes of standardization and quantification. The ongoing discussions on SEL, however, reveal still-emerging competing definitions and conceptualizations as an unsettled and thus subjectively contested science-in-the-making. SEL remains subject to a significant degree of practical objectivity-making and ongoing standardization, as each of the participating organizations in this emerging policy field is seeking to settle disputes about SEL through the production of quantitative objectivity. These contestations reveal how policy-influencing organizations are all seeking to resolve the interpretive flexibility of SEL science in order to standardize and fix it into policy—though it remains, as yet, a precarious achievement.

The data-scientific methods explored here importantly need to be seen in the context of increasing policy emphasis on objective evidence, the discourse of ‘what works’ and the advance of data-scientific policy approaches which mobilize psychological knowledge alongside data-processing technologies as ways to inform and shape education policy and practice. As the OECD (2015: xx) notes, ‘While everyone acknowledges the importance of social and emotional skills, there is insufficient awareness of “what works” to enhance these skills and efforts to measure and foster them.’ Yet as we have seen, the objectivity of ‘what works’ according to science is itself an accomplishment of complex ‘set ups’ and devices such as classification schemes and standardized scales. As a policy focus, SEL is the social achievement of micro-practices which extend from psychological laboratories, theory and measurement, through econometric analyses, morally-laden categories such as grit, character and ‘positive development,’ and are then mediated and transformed through the glossy brochures, websites and presentations of international policy influencers and technology vendors as policy-relevant knowledge. At each stage, policy objectivity is achieved through the translation of science into standardized scales, classifiers, frameworks, diagrams,

and memorable words and phrases, which resolve the interpretive flexibility of SEL into objective measures that can be captured as quantitative data using digital technologies. In this sense, ‘what works’ as policy-relevant objectivity and data-scientific policy knowledge is the contingent outcome of disciplinary, practical, technical, procedural and material processes that remain hard to accomplish in practice, yet continue to exert considerable power and influence in education policy.

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