The impact of bounded subadditivity on administrative behavior among public and private workers[1]

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Abstract

We use a mixed-methods sequential explanatory design to explore whether and how bounded subadditivity, and the resulting certainty effect, may lead public and private employees to prioritize their activities in ways that are suboptimal for their organizations. In a randomized controlled trial, private sector workers were more likely to join a project to which they were able to provide a small contribution that would turn the probability of success into certainty rather than an alternative project in which their participation would make success twice as likely but not certain. This behavior, which is consistent with the principle of bounded subadditivity, was not observed among public workers in our sample, who did not show any preference for either project. A qualitative inquiry suggests that the observed difference in susceptibility to bounded subadditivity between public and private employees resonates with public service motivation, self-determination theory, and identity economics.

Keywords: administrative behavior; bounded subadditivity; public versus private workers; mixed methods

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Public and private organizations have a legitimate interest that their employees prioritize activities that maximize value to the company. However, behavioral sciences suggest that workers may have a tendency to allocate their efforts in ways that are suboptimal for their organization. In this study, we explore bounded subadditivity as one of the behavioral mechanisms that can cause a systematic divergence between self- and organizational interest, thus ultimately leading to a loss of productivity. The principle of *bounded subadditivity* (Tversky and Fox 1995, Tversky and Wakker 1995) states that "an event has greater impact when it turns impossibility into possibility, or possibility into certainty, than when it merely makes a possibility more or less likely" (Tversky and Fox 1995, 271). Bounded subadditivity postulates that "individuals place an added value on the complete elimination of risk" (Viscusi et al. 1987, 468).

In the context of administrative behavior (Simon 1947), the certainty premium effect might lead workers to prioritize projects in which their participation would turn an already high probability of success into certainty, over projects in which their participation would make success substantially more likely though not certain. We explored the dynamics of bounded subadditivity on a sample of public and private workers. Using a mixed-methods sequential explanatory design that triangulates findings from a randomized controlled trial with results from a qualitative inquiry, we tested whether and why employees from the two sectors are likely to spend excessive time and effort on projects that have great prospects of success, in an attempt to reduce to zero a slim chance of failure, at the expense of projects in which their participation would make success substantially more likely though not certain.

At its core, thus, bounded subadditivity is the principle of reference for our investigation. On the one hand, the manipulation in our experiment draws on extant evidence about the certainty premium effect. Moreover, we explore the impact of the certainty premium effect on public sector employees relative to their peers in the private sector so as to identify any differences. On the other hand, in our qualitative analysis, we deductively pinpoint recurring

themes consistent with bounded subadditivity. At the same time, an inductive exploration of our qualitative responses unveils that individuals' allocation of their job efforts in ways that may be suboptimal for their organization nicely resonate with theories on individuals' work motivation and identification with their team and organization. Seminal work on administrative behavior by Herbert Simon stressed the necessity "to study the relation between the personal motivation of the individual and the objectives toward which the activity of the organization is oriented" (Simon 1947, p. 14). Our inductive coding identifies themes that are consistent with public service motivation (Perry and Wise 1990; Perry, Hondeghem, and Wise 2010; Ritz, Brewer, and Neumann 2016), self-determination theory (Deci, Olafsen, and Ryan 2017; Deci and Ryan 1985; Deci and Ryan 2000), and identity economics (Akerlof and Kranton 2000, 2005).

Our research provides the following contributions to scholars and practitioners alike. Firstly, our work may be valuable in expanding the scope of behavioral public administration research (Battaglio, Belardinelli, Belle, and Cantarelli 2019; Grimmelikhuijsen, Jilke, Olsen, and Tummers 2017). Indeed, to the best of our knowledge, no previous studies in this area has tested the effect of bounded subadditivity on administrative behavior contrasting public versus private sector employees. Secondly, the triangulation of experimental and qualitative data not only provides an unbiased estimate of the average effect size of certainty premium on job effort but also illuminates the micro-mechanisms through which this effect may display.

THEORETICAL BACKGROUND

Expected utility theory (Von Neumann and Morgenstern 1944; Bernoulli 1954) emerged as a model used to describe decision making under risk. In a nutshell, expected utility theory predicts that, when making a decision, a rational actor weights the utility of each possible outcome according to its probability of occurrence. More than descriptive, such a model has proved to be normative, as real decision makers have been widely shown to behave differently from the featured rational decision maker who has clear and comprehensive knowledge of the

environment, a well-organized system of preferences, and excellent computational skills to allow for the selection of optimal solutions. To the contrary, behavioral science scholarship suggests that individuals tend to be predictably sensitive to the environment in which they make decisions (e.g., Kahneman 2011; Thaler and Sunstein 2008). Systematic deviations from predictions of rational decision making models, or cognitive biases, are now an established area of research across disciplines. These include applied psychology (e.g., Kahneman 2011), economics (e.g., Thaler 2015), general management (e.g., Cornelissen and Werner 2014), marketing (e.g., Ariely 2010), and medicine (e.g., BlumenthalBarby and Krieger 2015; Saposnik et al. 2016). Public administration scholars have also been at the forefront on the use of behavioral sciences to advance theory and practice in our field as far as citizens, civil servants, and policy makers' decision making is concerned (Battaglio et al. 2019; Grimmelikhuijsen, Jilke, Olsen, and Tummers 2017; Tummers 2020). Most of this work branches out from prospect theory (Tversky and Kahneman 1979, 1992).

Extant behavioral science evidence shows that when falling prey to the zero-risk bias, subjects prefer eliminating rather than mitigating a certain risk even when alternative courses of action would yield superior outcomes, such as a larger reduction of the overall risk. The zero-risk bias unfolds in risky choices (i.e. when all probabilities are known) in which one of the alternatives turns a probability event into a certain event. Tversky and Kahneman's prospect theory (1979, 1992), which has extended expected utility theory in trying to provide a more descriptive theory of risky choices, does not fall short in explaining zero-risk bias. By replacing probabilities with decision weights, prospect theory postulates a nonlinear transformation of the probability scale. In particular, the *weighting function* is such that decision makers, on the one hand, overweight very low probabilities and underweight moderate and high probabilities while, on the other hand, they overweight outcomes that are considered certain relative to outcomes which are merely probable (Tversky and Kahneman 1979, p. 265). The zero-risk bias nurtures the certainty premium, whereby individuals are willing to pay a premium for reducing a risk to

zero. Viscusi et al. (1987) argue that "certainty premiums exist if, for any given risk change, individuals place an added value on the complete elimination of risk" (468). In their classic study of consumer willingness to pay for limiting health risks of two market products, Viscusi and colleagues (1987) found that "for all four injury pairs at most 11% of the subjects stated a marginal value for the 10/10,000 to 5/10,000 risk reduction that was greater than their value for the 5/10,000 to 0/10,000 risk reduction, and the large majority expressed a lower value for the first risk reduction than for the second" (476).

These patterns of behaviors are consistent with the principle of *bounded subadditivity* (Tversky and Fox 1995, Tversky and Wakker 1995), which came as an extension to prospect theory and has been tested in experiments involving both risky and uncertain prospects (Tversky and Fox 1995; Fox, Rogers and Tversky 1996). According to this principle, "an event has greater impact when it turns impossibility into possibility, or possibility into certainty, than when it merely makes a possibility more or less likely" (Tversky and Fox 1995, 271). In particular, upper subadditivity incorporates the *certainty effect* (i.e., zero-risk bias), such that the impact of an event is greater when it is subtracted from a certain event, in which no risk is involved, than when it is subtracted from some possible event.

Based on these theoretical premises, our first research question is whether bounded subadditivity, and the resulting certainty premium bias, affect individuals' decision so that they prioritize their activities in ways that are suboptimal for their organizations. Adopting a descriptive - rather than normative - approach, then, we deepen our investigation by exploring whether and how the principle of bounded subadditivity affects public and private sector employees differently.

Long-standing interdisciplinary research has investigated whether and how public and private sector workers tend to diverge, on average, in terms of their work motivation and identification with their tema and mission of their organization. In fact, such differences may systematically influence individuals' allocation of time and effort among job projects in which

self- and organizational interests clash. As to the former, public service motivation is a form of other-oriented behavioral attitude characterized by a "predisposition to respond to motives grounded primarily or uniquely in public institutions and organizations" (Perry and Wise 1990, 368). Latest research clarifies that although public service motivation is not uniquely found in government organizations, "it is grounded in the tasks of public service provision, and is more prevalent in government than other sectors" (Perry, Hondeghem and Wise 2010, 682). Native to the public administration field, public service motivation has been recently reconciled within self-determination theory (Bellé and Cantarelli 2015, 2018). Within self-determination theory (Deci and Ryan 2000), external regulation is the most self-undetermined state, under which "people behave to attain a desired consequence such as tangible rewards or to avoid a threatened punishment" (Deci and Ryan 2000, p. 236). When acting under introjected regulation, individuals are driven by internal pressures that include pride, guilt, a need for self-approval or approval from others, and/or the willingness to behave for others' sake. When the pressure to act is neither external nor internal, subjects fall in the identified regulation state and act consistent with a personal value system, which may include the desire to benefit others. Under integrated regulation, individuals identify with a given activity's value to the extent that it becomes internalized as part of his/her habitual functioning and self-identity. Intrinsic motivation, instead, is a fully self-determined state that emanates from the pure interest in and enjoyment of the work tasks and activities in and of themselves.

As to how public and private sector employees' identification with their team and organization may influence their willingness to put high rather than low effort in different projects, identity economics provides useful insights (Akerlof and Kranton 2000, 2005). Identity economics acknowledges that material self-interest might not be the only driver of individuals behavior. Rather, "employees may have identities that lead them to behave more or less in concert with the goals of their organizations" (Akerlof and Kranton 2005, p. 10). In other words, the more the workers identify with the organization, the higher their effort in trying to meet

organizational goals (Akerlof and Kranton 2010). In our context, workers might be less interested in attaching themselves to successful programs and more interested in increasing the overall probability of success of organizational programs if they identify with their organization. To what extent this happens might depend also on the type of the organization they belong to. Interestingly, Akerlof and Kranton (2005) widely use a case study by Lipsky (2004) on the US Military Academy in order to back their arguments. Some organizations, especially in the public sector, are mission-oriented and their mission is one of their identifying features that might affect workers' motivation (Resh, Marvel, and Wen 2018: Smith 2006; Weiss and Piderit 1999; Wright 2007).

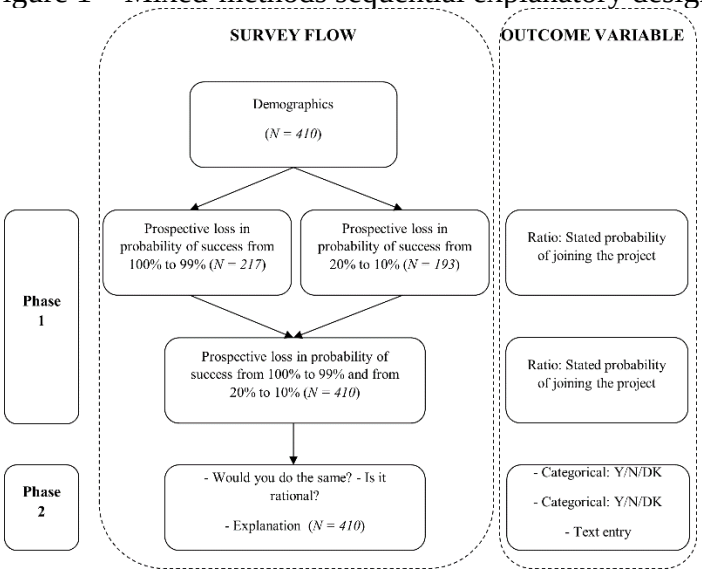
METHODS

Our mixed-methods sequential explanatory design (Mele and Belardinelli 2019) consisted of the two phases described in Figure 1. Phase 1 features a randomized controlled trial aims at testing any certainty premium effects on administrative behavior. All participants were asked to imagine that a group of colleagues invited them to join an organizational improvement project. Subjects were then randomly assigned to one of two treatments, A or B. Citizens allocated to treatment A read that the probability of success of the project would decline from 100% (certain success) to 99% without their contribution. Citizens assigned by chance to treatment B, instead, read that the probability of success of the project would fall from 20% to 10% without their contribution. In other words, failing to contribute to the project would reduce the probability of success by 1% - departing from certainty - for participants in one arm of the experiment and by 50% - though not departing from certainty - for their counterparts in the other arm. The outcome variable of the randomized controlled trial is the stated probability of joining the organizational improvement project. In particular, all participants were asked to indicate how likely it was that they decided to participate in the project on a 0-100 scale. Then, participants were exposed simultaneously to both treatment A and treatment B. This step was meant to investigate whether a real time

comparison of the two scenarios could debias participants' decisions. Subjects indicated their willingness to join the organizational improvement initiative for each of the two treatments.

Phase 2 is a qualitative inquiry meant to investigate the micro-mechanisms behind the decision of joining organizational change projects in which self- and organizational interest clashes. In other words, following a sequential explanatory design (Mele and Belardinelli 2019), the qualitative phase is aimed at explaining the results observed in the experimental phase. Participants read a short paragraph explaining that individuals tend to exert the same effort to avoid a reduction in the probability of success of a project from 100% to 99% or a reduction of the same probability from 20% to 10%, thus exerting the same effort to avoid a loss of 1 percentage point - that would be subtracted from a certain success - or a loss of 10 percentage points - that would not be subtracted from a certain success. After reading this piece of information, subjects indicated (i) whether they would behave in the same way (Yes/No/Don't know); (ii) whether they considered that behavior to be rational (Yes/No/Don't know); and (iii) explain why some people exert the same effort to avoid a 1 percentage point loss in the probability of success from 100% to 99% or to avoid a 10 percentage point loss in the probability of success from 20% to 10% (text entry). The full text of the vignettes included in our survey is reported in the online Appendix.

Figure 1 – Mixed-methods sequential explanatory design



In hand coding the open-ended questions, we adopted two complementary approaches. On the one hand, we used deductive a-priori coding (Krippendorff 2004), which entailed classifying open-ended responses against the tenets of bounded subadditivity theory. More precisely, each of the authors traced respondents' statements back to the logical dimensions of bounded subadditivity of and resolved any coding inconsistencies through discussion and final consensus. For example, we classified any reference to misunderstanding of probabilities, loss aversion, and certainty of success as instances that are consistent with the principle of bounded subadditivity. On the other hand, each of the authors adopted data-driven inductive coding to make synthesis of recurring statements that broadened or deepened our understanding of citizens' stated behavior. Authors reconciled any differences in inductive coding through argumentations until reaching agreement. In particular, we identified themes consistent with public service motivation, such as commitment to public interest, with self-determination theory, such as personal success, obligation to do the best, and enjoyment of job tasks, and with identity economics, such as team membership and organizational membership. Overall, our deductive and inductive coding was meant to allow themes to emerge from citizens' responses, rather than to measure rates of responses or frequency of specific constructs (Fereday and Muir-Cochrane 2006; Krippendorff 2004).

Our sample is composed of 410 Italian citizens, recruited in July 2019 through the *Qualtrics Software Company*. Qualtrics ensured the representativeness of respondents compared to the Italian working age population along the following demographic characteristics: gender, age group, education, employment status, and sector of employment.

RESULTS

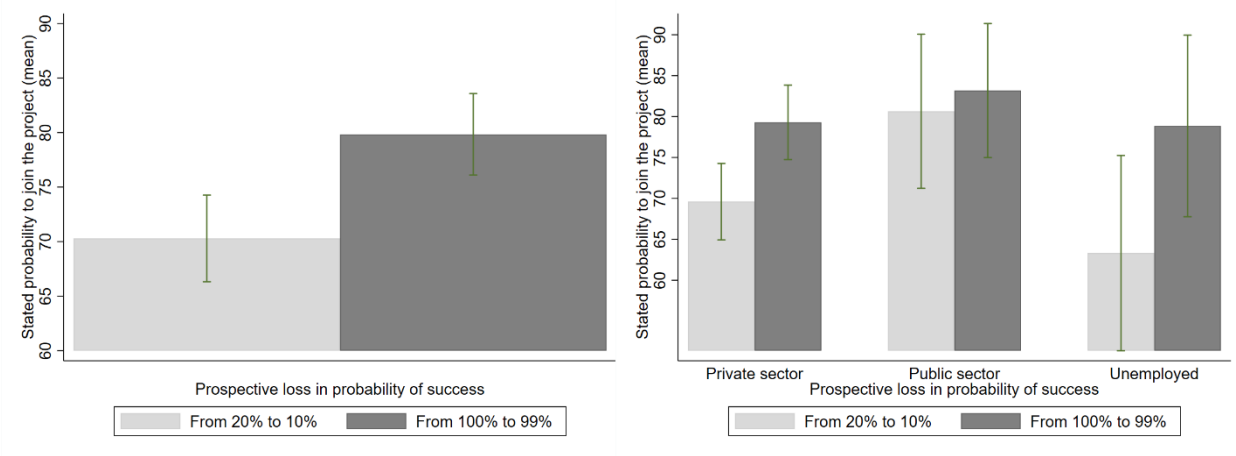
Of the 410 citizens in our sample, about 50 percent is female and 50 percent male. About 14 percent of subjects are between 18 and 24 years-old, 23 percent between 25 and 34, 42 percent between 35 and 49, and the remaining 21 percent between 50 and 65. About 20 percent of

participants hold at least an undergraduate degree, 48 percent a high school certificate, and the remaining 32 percent did not reach the end of high school. About 70 percent of the sample work in the private sector, 15 percent in public sector employees, and 15 percent is unemployed (the online appendix shows the English translation of the item used to identify their sector of employment).

As far as the randomized controlled trial is concerned, as expected due to randomization, participants in the two arms of Phase 1 did not differ at the .05 significance level in terms of gender, age, education, and sector of employment. A one-way analysis of variance revealed that participants exposed to a sure success option (i.e. treatment A) were more likely to join the organizational project than respondents exposed to a risky option (i.e. treatment B) (n = 217, M = 79.8, SD = 27.97; n = 193, M = 70.3, SD = 27.92; $p<.001$). In other words, a 1% decline in the probability of success that turned a sure success into a 99% probable success triggered more willingness to participate in the project than a 10% decline in the probability of success that halved the likelihood of success from 20% to 10%. The average treatment effect is about one third of the outcome variable's standard deviation (Figure 2, left panel).

The right panel of Figure 2 breaks down the results by citizens' sector of employment. While a statistically significant effect of the treatment can be detected for both unemployed participants (treatment A: n = 33, M = 78.8, SD = 31.30; treatment B: n = 28, M = 63.3, SD = 30.77; $p<0.1$) and participants employed in the private sector (treatment A: n = 150, M = 79.3, SD = 28.19; treatment B: n = 137, M = 69.6, SD = 27.70; $p<.001$), subjects employed in the public sector did not follow the same behavioral pattern. In particular, there was no statistically significant difference in the likelihood to join the project among public sector employees exposed to treatment A and public sector employees exposed to treatment B (n = 34, M = 83.2, SD = 23.48; n = 28, M = 80.6, SD = 24.29; $p=.679$).

Figure 2 – Average stated probability of joining the project (RCT), by prospective loss in probability of success (left-hand panel), and by employment status (right-hand panel)

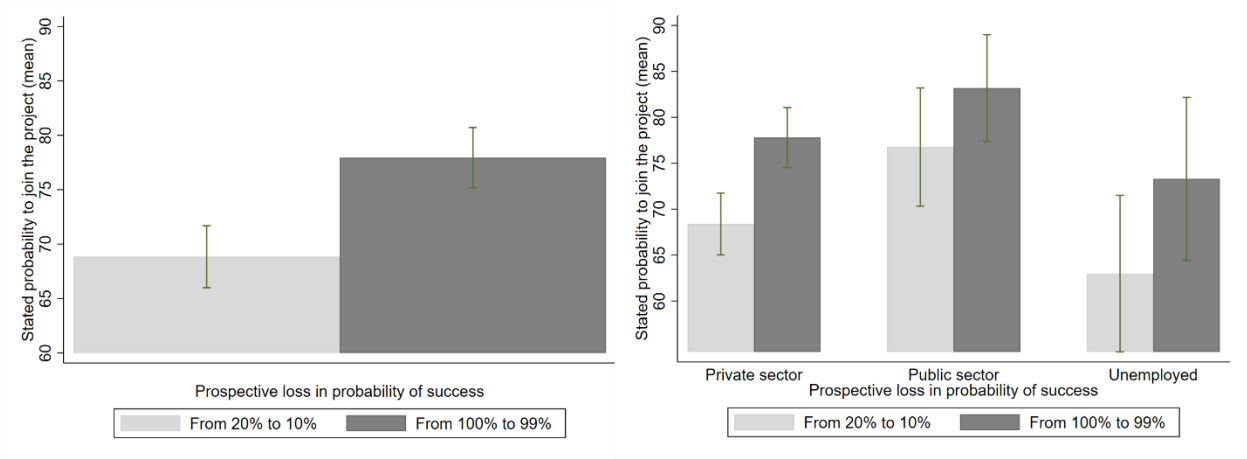


The same pattern of results emerged when respondents stated their willingness to join the project for both treatment A and treatment B simultaneously. More precisely, a one-way analysis of variance showed that participants were more likely to participate in the organizational project when the prospective loss in the probability of success was from 100% to 99% as compared to when the prospective loss was from 20% to 10% (n = 410, M = 77.9, SD = 28.47; n = 410, M = 68.8, SD = 29.34; $p<.001$). Thus, the simultaneous exposure to a 1% loss in probability of success departing from certainty and to a 50% loss in probability of success not departing from certainty as opposed to the random exposure to one of the two losses did not affect the outcome variable (Figure 3, left panel).

The right panel of Figure 3 breaks down the results by citizens' sector of employment. Results show the same patterns observed in the randomized control trial. Both unemployed subjects (treatment A: n = 61, M = 73.3, SD = 34.63; treatment B: n = 61, M = 63.0, SD = 33.24; $p<.05$) and subjects employed in the private sector (treatment A: n = 287, M = 77.8, SD = 28.02; treatment B: n = 287, M = 68.4, SD = 29.01; $p<.001$) were significantly more likely to participate in project A than in project B. As for public sector employees, the difference in the likelihood to participate in the projects is not statistically significant at the conventional .05 level

(treatment A: n = 62, M = 83.2, SD = 22.89; treatment B: n = 62, M = 76.8, SD = 25.34; *p=.097*).

Figure 3 – Average stated probability of joining the project (scenarios simultaneously shown), by prospective loss in probability of success (left-hand panel), and by employment status (right-hand panel)



Findings from phase 2 provide a fine-grained understanding of why bounded subadditivity tends to influence administrative behavior when self- and organizational interest clashes. When informed that empirical evidence suggests that people commit the same way in order to avoid a loss of 1 percentage point that departs from a certain success or a loss of 10 percentage points that does not depart from a certain success, 67.3 percent of participants in our survey judged this commitment to be rational, 23.7 percent to be not rational, and the remaining 9 percent didn't know. When asked whether they would exert the same effort in the two circumstances, 70.1 percent of subjects provided an affirmative answer, 15.4 percent a negative one, and the remaining 13.9 percent didn't know. It is interesting to note that the proportion of subjects deeming the behavior as not rational and nevertheless stating that they would behave the same way under the circumstances was higher among public sector employees (.13) than among non-public sector employees(.06).

Table 1. Number of respondents by judgment of rationality of exerting the same effort in the two job scenarios and by judgment of whether they would do the same.

Public employees		**Rational**			
		Yes	*No*	*D. K.*	*Total*
Would do the same	*Yes*	39	**8**	1	48
	No	4	6	0	10
	D. K.	1	1	2	4
	Total	44	15	3	62
Others		**Rational**			
		Yes	*No*	*D. K.*	*Total*
Would do the same	*Yes*	208	**20**	14	242
	No	12	38	3	53
	D. K.	12	24	17	53
	Total	232	82	34	348

The qualitative responses to our open-ended questions allow us to dig deeper into the mechanisms behind individual decisions to join organizational projects. We deductively identified recurring themes on how respondents explain why some people exert the same effort to avoid a 1 percentage point loss in the probability of success from 100% to 99% or to avoid a 10 percentage point loss in the probability of success from 20% to 10%, thus exerting the same effort to avoid a loss of 1 percentage point or a loss of 10 percentage points. Recurring themes consistent with the theoretical framework inspiring our experimental design, namely bounded

subadditivity, included the will of not losing any probability in the success of a project, the pursuit of certainty of success, and the predominant misunderstanding of probabilities. Some participants provide explanations consistent with *loss aversion* and explain that people in general want to avoid losses. For example, one participant explicitly mentions that "It's a loss in any case, and nobody wants to lose any probability of success, not even 1%". Another explains: "I think it is important to commit to the project so to avoid any loss in the probability of success". The second recurring theme consistent with bounded subadditivity revolves around the *certainty premium*, so that some respondents believe that reaching 100% of probability of success deserves a non-linear transformation in effort. In other words, the opportunity of guaranteeing certainty of success overweights the opportunity of increasing probability of success for merely probable outcomes. Thus, "100% of probability of success is worth all the effort, even though you contribute only 1 percent". A third recurring theme relates to the *misunderstanding of probabilities*. In this case, respondents would not expect to observe the same effort in the two organizational projects. If this happens, it must be because "people in general are not rational and they do not understand statistics." Indeed, as explained by another respondent, "different losses in probability require different levels of effort. If the risk is to lose only one percentage point it's not an issue as big as to lose 10 percentage points."

Lastly, an inductive analysis of the qualitative responses to our open-ended questions identify recurring themes consistent with theoretical perspectives suitable to expand our understanding of the forces that may drive individuals' decisions to allocate time and effort to projects that are not in the best interest of their organizations. In particular, a group of recurring themes was related to self-determination theory, such as self interest and organizational interest as falling under the external regulation state, and moral obligation as falling under the identified/integrated regulation state. Another group of recurring themes was consistent with other theoretical perspectives, such as identity economics and PSM. Themes related to the former include teamwork, team success, organizational success, and sense of responsibility

towards the organization, while we identified the recurring theme of public interest as related to the latter. Table 2 provides the final structure of the coding, including second-order themes, first-order codes, and some examples of quotes from the answers supporting our coding. Additional illustrative quotations are reported in the online Appendix.

Table 2. First-order and second-order themes emerging from open-ended questions on the reasons for exerting the same effort on the two projects.

Hand coding process	Theoretical framework	Second-order themes	First-order codes and quotes
Deductive	Bounded subadditivity	Loss aversion	Do not lose probability of success
			"I think it is important to commit on the project so to avoid any loss in the probability of success"
			"It's a loss in any case, and nobody wants to lose any probability of success, not even 1%"
			"In all cases, people try to avoid any losses in the probability of success"
		Certainty premium	Certainty of success
			"Cause in the first case one's presence guarantees certainty of success, while in the second this is not the case"
			"Cause in the first case the success of the project is certain"
			"100% of probability of success is worth all the effort, even though you contribute only 1 percent"
		Misunderstanding of probabilities	Misunderstanding of probabilities
			"I don't know why. I would not behave the same in the two cases, as in one case my contribution doesn't have a huge impact while in the other case the probability of success is doubled by my contribution"
			"It makes no sense. Different losses in probability require different levels of effort. If the risk is to lose only one percentage point it's not an issue as big as to lose 10 percentage points"
			"People in general are not rational and they do not understand statistics"
Inductive	Public service motivation	Public interest (PSM)	Public interest
			"Whatever it takes to protect the public interest"
			"They make an effort in doing their best for other people trying to improve the society"
			"For the good of all"
	Self-determination theory	Self interest (external regulation)	Personal success
			"Reaching the goal is essential for ambitious people"
			"Because hard work always pays off and hard work makes you satisfied"
			"Maybe they are ambitious and constant over time and they don't want to lose anything"
			Preserve/improve job-conditions
			"Because with more success and less failures the job will be preserved over time"
			"Make your best under any conditions. If you make your best you improve your conditions within the organization and you become a reference point"

			"Because they want to improve their job conditions"
		Organizational interest (external regulation)	Contribute to the organization
			"To avoid any possible damage to their organization"
			"Because maybe they want the best outcome for every project, so to endure an improvement for their own organization"
			"Maybe they commit the same way in order to avoid to put their organization in a bad light"
		Moral obligation (identified/integrated regulation)	Must do your best
			"Because it's just like this. You must always commit on the projects so to avoid any losses"
			"You must always make your best in every moment of your life and work-life"
			"Percentage points do not matter. You must always commit 100%"
		Intrinsic motivation	Enjoy the work tasks
			"They don't care about the results but they work just for fun"
			"They are passionate about their work and therefore they put all the effort"
	Identity Economics	Team membership	Teamwork
			"To work as a team"
			"For the sake of collaboration and connection in a close-knit team"
			"To be efficient and not to waste your and others' time"
			Team success
			"You assume this attitude in order for everybody to achieve success […] you do everything for the team"
			"The success of a group goes beyond one or ten percentage points, if my contribution can increase the chances of success then my effort will be maximum"
			"Because they have a goal to achieve and they know how to work as a team"
		Organizational membership	Organizational success
			"Because they want the best for their organization"
			"In my opinion this is to have a return of image for themselves and for the organization"
			"Willingness to improve and to be at the center of an ambitious project for the organization"
			Sense of responsibility towards the organization
			"For a sense of responsibility towards the colleagues and the organization"
			"Professional ethics and respect for the colleagues and the employer"

Consistent with the *external regulation* state from self-determination theory, under which behavior is triggered by the expectation of attaining a desired consequence such as tangible rewards, recurring themes include self interest (i.e., reaching personal success and improve job conditions) and organizational interest (i.e., contribute to the organizational success). As for self interest, "reaching the goal is essential for ambitious people". Workers exert

the same level of effort regardless of the probability of success, “because hard work always pays off” and, as another respondent points out, “because they want to improve their job conditions”. Some respondents emphasize organizational interest, so that workers want “to avoid any possible damage to their organization” and they exert the same effort “because maybe they want the best outcome for every project, so to endure an improvement for their own organization”. Moral obligation (i.e., it’s just to commit on projects, regardless the probability of success) is a recurring theme that we related to the *identified/integrated regulation* state, according to which subjects and act consistent with a personal value system. Therefore, as clarified by one respondent, individuals commit the same on the two projects “because it's just like this”; another respondent explains that “you must always make your best in every moment of your life and work-life”. The last recurring theme identified relates to intrinsic motivation, which is driven by enjoyment of the job tasks. Respondents here explain that individuals exert the same level of effort because, for example, “they don’t care about the results but they work just for fun” or, as pointed out by another respondent, “they are passionate about their work and therefore they put all the effort”.

Consistent with the literature on public service motivation, and in particular with one of its associated dimensions, namely commitment to public interest or civic duty (Perry 1996; Wright, Christensen, and Pandey 2013), some respondents from our sample support the idea of exerting the same level of effort in the two programs “for the good of all”, “to improve the society”, and because it is just to do “whatever it takes to protect the public interest”.

Consistent with identity economics, respondents emphasize *team membership* as one factor leading them to exert the same level of effort in the two projects. In this respect, on the one hand, they felt as important the willingness “to work as a team”; on the other hand, they want to contribute to the success of the team, for “the success of a team goes beyond one or ten percentage points”. Other respondents deemed *organizational membership* as an important driver of this behavior, by going beyond the immediate colleagues part of their team. In particular,

respondents in this case feel that workers want to contribute to the organizational success as they "want their best for their organization", but also feel "a sense of responsibility towards their colleagues and the organization".

DISCUSSION AND CONCLUSION

Building on the *bounded subadditivity* principle (Tversky and Fox 1995, Tversky and Wakker 1995), our mixed-methods sequential explanatory study aims at investigating whether and why public and private sector workers may prioritize projects in which their participation would turn an already high probability of success into certainty, over projects in which their participation would make success substantially more likely though not certain. In so doing, our work seems to nicely nurture behavioral public administration, where research in this area is still scant (e.g., Battaglio, Belardinelli, Belle, and Cantarelli 2019; Grimmelikhuijsen, Jilke, Olsen, and Tummers 2017).

We find a certainty premium effect, whereby the propensity to engage in a project is higher among participants exposed to a one percentage point decline in the probability of success that turned a sure success into a 99% probable success than among their counterparts exposed to a ten percentage points decline in the probability of success that halved the likelihood of success from 20% to 10%. This result resonates with prospect theory prediction that "outcomes which are obtained with certainty are overweighted relative to uncertain outcomes. In the positive domain, the certainty effect contributes to a risk averse preference for a sure gain over a larger gain that is merely probable" (Kahneman and Tversky 1979, 268). We further find that the certainty premium effect is robust to variations of the experimental design. More precisely, even when exposed to both experimental treatments simultaneously, the stated intention to engage in the organizational change initiative remains higher for the project with a certain success. Thus, prompting participants to compare how much of a difference their contribution could make for an organizational change project does not seem to be enough to debias the certainty premium

effect. Indeed, employees showing bounded subadditivity may spend time and energy in organizational initiatives in which their contribution turns a large probability of success into a certain success and neglect other activities in which their contribution doubles the probability of success, but this remains risky rather than a sure thing).

The certainty premium effect (or zero-risk bias), though, plays out differently for civil servants relative to their counterparts in private organizations. Our analyses suggest that, compared to the rest of the population, public employees are more willing to join a project with lower chances of success in which they can double that probability. In other words, the probability of joining an organizational change project among workers in public organizations is independent from the magnitude of the prospective loss in the probability of success and overall success chances. This finding adds novel evidence to the public administration scholarship that focuses on better understanding the similarities and differences between managing organizations and their employees in the public and private sector (e.g., Bullock, Stritch, and Rainey 2015; Boyne, Poole, and Jenkins 1999; Bozeman and Bretschneider 1994).

As to the micro-mechanisms that underlie workers' bounded subadditivity, our qualitative investigation reveals that different theoretical perspectives might drive our quantitative results. Consistent with bounded subadditivity, individuals tend to be psychologically wired to avoid losses and misunderstand probabilities. This triggers irrational behaviors, such as exerting the same effort to avoid any decline in probability of success. Further inductive - rather than deductive - analyses seem to suggest that the observed behavioral patterns can be informed by self determination theory - including factors like one's desire to achieve personal benefits and intrinsic motivation - by identity economics, as the motivation to reach organizational goals plays an important role - and by public service motivation - when subjects respond to their predisposition to serve the public interest. These findings further expand the well-established research area on how work motivation may have an impact on effort (e.g.,

Bozeman and Su 2015; Christensen, Paarlberg, and Perry 2017; Ritz, Brewer, and Neumann 2016; Marvel and Resh 2018; Perry 2014).

Our findings should be interpreted in light of several limitations. First of all, we are unable to disentangle the impact of the two factors that are conflated in our manipulation, i.e. the magnitude of the prospective loss and the departure from the certainty of success. In light of behavioral science evidence in these two domains, future studies employing full factorial designs would be highly valuable in testing the relative impact of certainty premium and loss aversion in decision-making. Secondly, although our results seem to speak to extant evidence that people may be more willing to be associated with and participate in projects with better prospects out of reputational concerns, our research design cannot unveil any causal linkages between reputational motives and job effort. Thirdly, while our data allow us to distinguish between public and private sector workers, we can neither identify workers from nonprofit organizations nor tell the specific industry in which our respondents are employed. Future research might explore whether our results replicate across units, treatments, operations, and settings. Promising research questions relate to whether the sector of employment (public vs private) still matters in explaining different behavioral patterns when you can control for industry of employment (so as to isolate the effect, for example, of mission-driven organizations, regardless of their ownership structure).

Our work may be valuable to public administration scholars and practitioners - either policy makers or public managers - alike. From a theoretical standpoint, to the best of our knowledge, no previous studies in public administration has tested the effect of bounded subadditivity on administrative behavior contrasting the attitudes of public versus private sector employees. In addition, we adopt a multi-disciplinary approach in order to explain our experimental findings. Scholars in our discipline have reconciled public service motivation, which is native to public administration (Perry and Wise 1990), with self-determination theory (e.g., Deci and Ryan 2000; Deci, Olafsen, and Ryan 2017), which comes from psychology, to

have a more nuanced understanding of work motivation (Bellé and Cantarelli 2015, 2018). We take advantage of this existing scholarship and add further insights from economics (i.e, Akerlof and Kranton 2010) so as to explain our observed behavioral patterns. From a methodological standpoint, we take up the recent call in our discipline to leverage on the power of mixed-methods designs that facilitate the triangulation of findings (e.g., Mele and Belardinelli 2019). From a practical standpoint, then, our study may function as a cautionary tale for policy makers and public managers engaged in change management initiatives. Indeed, very well planned reforms may overlook clashes among personal goals, organizational interests, moral pressure, and cognitive biases that may ultimately represent a barrier to innovation in public administration (De Vries, Bekkers, and Tummers 2016).

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ONLINE APPENDIX

Survey text (English translation)

Sector of employment item: *In what sector are you employed? (Public sector (for example health authorities, public hospitals, police, public administration, etc.) / Private sector / Unemployed)*

Phase 1. Experimental scenarios[2]

Imagine that a group of colleagues invited you to join an organizational improvement project. With your contribution, the probability of success of the project is *100% (certain success)* [*20%*]. Without your contribution, the probability of success of the project would decline to *99%* [*10%*]. By moving the following slider, please indicate the probability that you will participate in the project.

Phase 2. Additional questions – qualitative inquiry

Some evidence suggest that individuals tend to exert the same effort to avoid a reduction in the probability of success of a project from 100% to 99% or a reduction of the same probability from 20% to 10%. In other words, it seems like they exert the same effort to avoid a loss of 1 percentage point or a loss of 10 percentage points.

1) Would you exert the same level of effort in order to avoid a loss of 1 percentage point (from 100% to 99%) in the probability of success or a loss of 10 percentage points in the probability of success? (*Yes/No/Don't know*)
2) Do you think it is rational to exert the same level of effort in order to avoid a loss of 1 percentage point (from 100% to 99%) in the probability of success or a loss of 10 percentage points in the probability of success? (*Yes/No/Don't know*)
3) Please, explain why some people exert the same level of effort to avoid a 1 percentage point loss in the probability of success (from 100% to 99%) or to avoid a 10 percentage point loss in the probability of success (from 20% to 10%). (*text entry*)

[2] The text in italics displays our experimental manipulations. The text in italics in the square brackets was inserted instead of the corresponding italics text in the vignette. After the randomized experiment, we simultaneously exposed subjects to both of the scenarios.

Additional quotes

Hand coding process	**Theoretical framework**	**Second-order themes**	**First-order codes and quotes**
Deductive	Bounded subadditivity	Loss aversion	Do not lose probability of success
			"I think it is important to commit on the project so to avoid any loss in the probability of success"
			"It's a loss in any case, and nobody wants to lose any probability of success, not even 1%"
			"It's a matter of character. Regardless of the size of the loss (it can be minimum or maximum), it is always a loss. "
			"So as not to lose anything"
			"So as not to lose, obviously. What other reasons might they have?"
			"In all cases, people try to avoid any losses in the probability of success"
		Certainty premium	Certainty of success
			"Cause in the first case one's presence guarantees certainty of success, while in the second this is not the case"
			"Cause in the first case the success of the project is certain"
			"It is possible that people want to attach themselves to successful projects and this favours the 100% probability of success"
			"Because they want to obtain a success with 100% probability and do not want to waste any energy"
			"100% of probability of success is worth all the effort, even though you contribute only 1 percent"
		Misunderstanding of probabilities	Misunderstanding of probabilities
			"I don't know why. I would not behave the same in the two cases, as in one case my contribution doesn't have a huge impact while in the other case the probability of success is doubled by my contribution"
			"It makes no sense. Different losses in probability require different levels of effort. If the risk is to lose only one percentage point it's not an issue as big as to lose 10 percentage points"
			"Not sure, I think most of the people just consider possible improvements without fully understanding percentages"
			"People in general are not rational and they do not understand statistics"
Inductive	Public service motivation	Public interest (PSM)	Public interest
			"Whatever it takes to protect the public interest"
			"They make an effort in doing their best for other people trying to improve the society"
			"For the good of all"
			"To help others"

	Self-determination theory	Self interest (external regulation)	Personal success
			"Reaching the goal is essential for ambitious people"
			"Because hard work always pays off and hard work makes you satisfied"
			"Because they want to have success in life"
			"To have success"
			"Maybe they are ambitious and constant over time and they don't want to lose anything"
			Preserve/improve job-conditions
			"Because with more success and less failures the job will be preserved over time"
			"Work makes you independent"
			"Make your best under any conditions. If you make your best you improve your conditions within the organization and you become a reference point"
			"Because they want to improve their job conditions"
		Organizational interest (external regulation)	Contribute to the organization
			"To avoid any possible damage to their organization"
			"For the growth of the company"
			"For the good results of the company"
			"Because maybe they want the best outcome for every project, so to endure an improvement for their own organization"
			"Maybe they commit the same way in order to avoid to put their organization in a bad light"
		Moral obligation (identified/integrated regulation)	Must do your best
			"Because it's just like this. You must always commit on the projects so to avoid any losses"
			"Sense of responsibility"
			"Professional ethics, honesty, desire to work"
			"You must always make your best in every moment of your life and work-life"
			"Percentage points do not matter. You must always commit 100%"
		Intrinsic motivation	Enjoy the work tasks
			"They don't care about the results but they work just for fun"
			"Evidently because they like the job they perform"
			"They are passionate about their work and therefore they put all the effort"
	Identity Economics	Team membership	Teamwork
			"To work as a team"
			"Fairness towards the other colleagues"
			"Because they want to feel part of a strong and cohesive team"

			"For the sake of collaboration and connection in a close-knit team"
			"To be efficient and not to waste your and others' time"
			Team success
			"You assume this attitude in order for everybody to achieve success […] you do everything for the team"
			"If you work in a team you need to commit in any case, in order to take everybody to success"
			"Because to work for the team always leads to good results"
			"The success of a group goes beyond one or ten percentage points, if my contribution can increase the chances of success then my effort will be maximum"
			"Because they have a goal to achieve and they know how to work as a team"
		Organizational membership	Organizational success
			"Because they want the best for their organization"
			"In my opinion this is to have a return of image for themselves and for the organization"
			"This attitude is taken in order to achieve the success of everybody"
			"Because they care about their company and they want it to have success without any losses"
			"Willingness to improve and to be at the center of an ambitious project for the organization"
			Sense of responsibility towards the organization
			"For a sense of responsibility towards the colleagues and the organization"
			"Because the projects fall within the organizational commitment, so the participation in the projects is required"
			"Professional ethics and respect for the colleagues and the employer"