

Intrinsic and Extrinsic Competition:

Winning the Rally versus Scoring the Point

By Ib Ravn

"Scoring a Goal" Means Two Things

Progressive educators caution against the dangers of excessive competition in physical education and physical activities (e.g., Duncan & Kern, 2020), sometimes citing a long list of negative outcomes (Cardinal et al., 2013). Instead, alternatives like moderation and cooperation are proposed.

However, many sports, like ball games and duels such as wrestling, fencing and the martial arts, cannot be executed meaningfully without athletes trying to beat the opponents, as the opponents are the very source of the challenges presented to athletes. Struggling to overcome these challenges constitutes the game and, ideally, makes it enjoyable and worthwhile. Remove the competition and you remove the fun.

Hence the apparent contradiction—and the problem to be addressed in this article: Competition in these sport games produces negative outcomes *as well as* enjoyment. How is that possible? Can we tease the two apart and turn one down and the other up?

We may answer this question by distinguishing between two aspects of competition. *Intrinsic* competition lies in the struggle to bring the current rally, play or round to its successful completion. *Extrinsic* competition lies in securing the point allotted to the winner of the rally. Distinguishing between fighting the rally and obtaining the point accruing to its winner is the issue here, although this is obscured by language. "Scoring a goal" means exactly what? Putting the ball between the goalposts or advancing the score from, say, 0–0 to 1–0? Both.

This article explores this paradox. Does an excessive emphasis on *extrinsic* competition contribute to the *negative* outcomes of competition (cheating, anxiety, exclusion, sense of failure, and dropout)? Conversely, will a sustained focus on *intrinsic* competition contribute to the *positive* outcomes of competition (enjoyment, perseverance, inclusion, sense of competence, retention)?

In what follows, the distinction between intrinsic and extrinsic *competition* will be contextualized within the literature on intrinsic and extrinsic *motivation*, especially in self-determination theory (SDT), as well the performance/mastery distinction of goal achievement theory. The distinction between intrinsic and extrinsic competition is then elaborated and applied to issues of cooperation, skill-level equality, and enjoyment in sport. Next, a number of negative consequences usually attributed to competition *per se* are addressed; more properly, they may be laid at the door of *extrinsic* competition. Finally, some practical suggestions are offered to educators who want to downplay extrinsic competition and emphasize intrinsic aspects. Concluding remarks summarize the conceptual and practical advances made possible by distinguishing intrinsic from extrinsic competition.

From Intrinsic *Motivation* to Intrinsic *Competition*

Although deriving from studies of primates (Harlow, 1950), the terms intrinsic and extrinsic were used extensively

in the study of motivation as championed by Edward Deci in the 1970s (Deci, 1975). Later, the distinction between intrinsic and extrinsic motivation became a mainstay of SDT (Deci & Ryan, 1985; Ryan & Deci, 2017) and was applied in sport early on (Vallerand et al., 1987). Subsequently, the distinction has been used extensively in physical education (Ntoumanis & Standage, 2009) and has been applied to coaching styles in sport (Mageau & Vallerand, 2003).

The terms refer to what motivates students and athletes in physical education, exercise, and sports: extrinsic factors like praise, wins, rankings, championships and the attendant social recognition, or intrinsic factors like enjoyment derived from playing the game (Davies et al., 2015), learning new skills and achieving mastery (Harwood et al., 2008), and getting one's needs for autonomy, competence and relatedness met (Vasconcellos et al., 2020).

Extrinsic motivation is characterized by the pursuit of the "separable outcome" (Ryan & Deci, 2017, p. 14), the outcome that is different from the enjoyment derived from doing the activity in itself. When a game or match is at issue, winning is usually portrayed as the separable outcome *par excellence*: the goals scored, the matches won, the medals and trophies, including the social recognition that goes with winning.

This view often aligns with the process-outcome distinction: "... the challenge(s) inherent in the process of competing [vs.] ... the outcome (that is, winning or losing)" (Beni et al., 2017, sec. 320). Physical education teachers are advised to nurture the process and downplay the outcomes—the outcomes being the winning, the touchdowns, the home runs, "making a kill," "wiping out the opponent." Indeed, it is often argued that competition per se must be brought under control and other emphases in physical education brought to the fore (Duncan & Kern, 2020). The whole domain of cooperative games (Dyson et al., 2004) is designed to appeal to cooperation, eschewing competition.

Usually, however, little is made of the two kinds of competition highlighted above and elaborated below: Competition (i.e., extrinsic) in the sense of players accumulating points and championships versus competition (i.e., intrinsic) in the sense of players giving themselves to the game 100% and trying to tackle whatever challenges are hurled at them by opponents trying to beat the them.

In motivational psychology, like SDT, the terms intrinsic and extrinsic are mostly associated with people's *motives* for engaging in activities. Additionally, one of the six minitheories that make up SDT, goal contents theory (Ryan & Deci, 2017, chap. 9), is concerned with the *goals* that people pursue. Scholars in SDT distinguish between two kinds of goal pursuits. One set is called extrinsic goals; they include wealth, popularity/ fame and image/attractiveness/thinness. Another set is called intrinsic goals, such as personal growth, intimate relations, and community contribution.

Extensive research has found that people who report they pursue extrinsic goals report lower scores on many wellness indicators, such as positive affect, life satisfaction, meaning and psychosocial functioning, and higher scores on psychological



and somatic problems, than people who say they pursue intrinsic goals (Kasser, 2016).

Applying this distinction between intrinsic and extrinsic *goals* to competition in sports and games entails attending to the intrinsic and extrinsic phases of competition and asking: What are the goals pursued by competitors? The extrinsic goal of winning points, tournaments, bragging rights and media coverage, or the intrinsic goal of immersing yourself completely in the application of energy and skills to forcing that ball bouncing or flying fast toward you into a known pattern (the hit, the smash, the kick) that masterfully advances the play and brings it to perfect completion (the basket, the goal, the win)? Thus, competitive sports may be considered one of the many domains of life and society that are amenable to analysis in terms of goal contents theory and SDT.

Consider another theory in the goal literature, achievement goal theory (Elliott & Dweck, 1988; Nicholls, 1989). It distinguishes between two goal orientations: performance, which is about reaching standards set by external agents and obtaining social recognition (hence, also called *ego orientation*), and mastery or learning, which involve the subject's progress, learning and increasing competence (*task orientation*).

Like the distinction between intrinsic and extrinsic *motivation*, the performance/mastery distinction is of the same cloth as the competition-specific distinction discussed here. Probably for this reason, Gleddie (2013), in passing, used the exact expression "intrinsic competition" in this context, in the sense of "the desire to outstrip one's previous achievements" (p. 277). However, the meaning of "intrinsic competition" introduced in this article is about the chronological sequence of, first, "the rally," and then, "the allocation of a point." The two stages are manifest phenomena, while the former distinctions apply to the worlds of experience, inclination and motivation of the people involved. In any case, we are in the same territory (Ntoumanis, 2001), except for the fact that the motivation and goal orientation theories mentioned do not break down the competitive situation in the rally-versus-point manner proposed here.

Defining Intrinsic Competition

Let us examine the distinction between intrinsic and extrinsic competition in more detail. We distinguish two aspects of competition that, in practice, are separated chronologically by a fraction of a second. Consider a rally or a play, the sequence that begins with a serve or kickoff and ends seconds or minutes later when one side crowns its efforts with success, or the playing/ fighting is interrupted and restarted. The physical exertion that the parties expend to complete the rally, including the struggle to defend against the opponents' attacks and launch counterattacks on them, again and again—this is the intrinsic aspect of competition. Let's call that *fighting the rally*. The subsequent, extrinsic aspect of the competition is *winning the point*. It materializes the instant the rally is over, when the referees (or the participants themselves) make the call and allocate a point to the winner. Many players and athletes, especially in the context of *formal* games and meets, may find the two aspects hard to tease apart. Once appreciated, however, the distinction will manifest itself phenomenologically as well, in people's experience. This is easier to do in the context of *informal* or *friendly* games, during practice, during physical education classes or the off-season, so to speak. In this friendly context, most players consider it less important to secure the point, which is not to say that players necessarily put less effort into each rally. Sometimes, young or insecure players will find it easier to play well during practice, as less anxiety is generated by the friendly game.

This is common knowledge to anyone involved in sport and competition. Likewise, any player can answer this question: "Imagine two days. One day you're in top form, you play terrific, but you lose narrowly to your friends or classmates. Another day you feel average, your game is mediocre, but you win narrowly over the same friends or classmates. Which is the better day?" Those favoring intrinsic competition will chose the former day; those favoring extrinsic, the latter.

It is a commonplace in sport that the intrinsic features of competition (the pleasure of fighting the rally) may be crowded out by the extrinsic features (the pressure to secure the point). This may tempt physical education teachers and sensitive parents to shun competition, in so far as they equate *competition* with *extrinsic competition*. If, on the other hand, the proposed distinction is borne in mind and acted on, teachers and players may retain and profit from the immersion and flow and sheer enjoyment of intrinsic competition—even turning competitive games into friendly and mutually enjoyable events as both parties acknowledge and celebrate the efforts of teammates and opponents alike, as we shall see below.

Consider three additional characteristics of intrinsic versus extrinsic competition.

First, it is often said that in a competition, only one can win, but in cooperation, everyone can win (and have fun). In other words, competition is seen as a zero-sum game, as is, in fact, the case in elimination tournaments-this being, of course, highly detrimental to the loser's motivation (Vallerand et al., 1986). But this old maxim is only true to the extent that the competition is framed as extrinsic, as in formal games and matches. Informally, during class, practice, leisure and pick-up games, competition may be kept intrinsic if teachers, instructors, parents and players choose to do so. If two opposing teams exchange a random player every 5 minutes, identification with "one's team" becomes harder, and the final score cannot mean much. This frees players to immerse themselves boldly and creatively in the current rally and worry less about the outcome of the game. In a psychologically safe atmosphere, everyone may be psyched to do their best and feel like winners.

Second, relative skill levels are key. In *extrinsic* competition, a large difference is relished by the stronger party, as this increases the likelihood of the all-important winning of points. However, it seriously demotivates the weaker party. In *intrinsic competition*, on the other hand, both parties tend to be frustrated by a large differential and stimulated by nearequality, as the latter tends to produce optimal challenges for both. Usually, little fun or experience of mastery can be had from too strong or too weak an opponent. To illustrate, Gleddie (2013) wrote, "The participants in this study ... recognized that they could feel good and have fun even in a losing effort. In fact, some athletes would rather lose a close game where their skills were challenged than win a game that was 'too easy" (p. 277). This fact is so obvious to any teacher or reflective player that its roots are rarely discussed. Here, these roots are named. The enjoyment deriving from intrinsic competition may only be experienced when players are (rendered) somewhat compatible and the importance of extrinsic competition (winning the match) is downplayed. Once realized and articulated, at least by teachers and coaches, this fact should facilitate inclusion of all participants, regardless of (dis)ability, experience or background.

Third, enjoyment may be directly associated with the intrinsic aspects of sport. Despite its popular appeal, the concept of enjoyment (or fun) in sport has remained scientifically elusive, possibly because of its subjective nature (but see Alderman et al., 2006; Visek et al., 2015). However, it stands to reason that once the 'serious business' of extrinsic competition has been singled out from sports, the remaining intrinsic features seem to constitute an obvious locus for the phenomenon of enjoyment. To be sure, fans derive tremendous enjoyment from seeing their team win, but this does not quite seem to be what sport scholars have in mind. It is reasonable to speculate that the fun or enjoyment of sport is intrinsic in nature, much like the flow experience has been defined as involving subjective immersion, loss of the sense of time, optimal challenges, feedback about performance, and so on (Jackson & Csikszentmihalyi, 1999).

Are Negative Effects Due to *Extrinsic* Competition?

Addressing our opening problem, it seems evident that many of the negative effects of competition may be attributed to *extrinsic* competition, not competition *per se*. (Likewise, some positive outcomes may arise from intrinsic competition specifically.) The following speculations may be framed as hypotheses postulating antecedents, and they may be tested empirically:

- 1. Negative affect and psychological problems. The (extrinsic) pressures to perform and win, whether these pressures are internal or external, likely play a major role in the many well-known negative psychological effects of competitive sports: anxiety, fear of failure, shame of having lost, diminished self-confidence (Choi et al., 2014), as well as mental health issues like rumination, depressive symptoms, eating disorders (Currie, 2010), and so on (Uphill et al., 2016).
- 2. Social rejection. Competitive games highlight comparative disadvantages in players and engender derogatory remarks, harassment, social marginalization, and ex-

clusion. The extrinsic emphasis on winning seems an obvious culprit here, although apparent inability or unwillingness to commit to the intrinsics may also conceivably be a motive for social exclusion ("Why don't you fight as hard as everyone else?").

- 3. Dropping out. One review of studies of dropouts from organized sport among children and youth identified five factors involved: enjoyment, perceptions of competence, social pressures, competing priorities ("Having other things to do"), and physical factors (injuries and maturation) (Crane & Temple, 2015). The distinction between intrinsic and extrinsic competition would seem relevant to the first three factors at least, as in "I'm not having enough fun" (because winning is allimportant?), "I don't feel I'm good enough" (because rankings are emphasized?), and "I'm expected to win all the time."
- 4. *Cheating*. The very purpose of cheating is to adduce points. Concealing one's own fouls, calling a serve out when it's in, flopping, and so on: Opportunities for minor transgressions abound. The more of an emphasis on *extrinsic* competition, the more cheating may be predicted (controlling for refereeing: Other things being equal, the presence of a referee may deter cheaters, rendering friendly games more susceptible to cheating after all).
- 5. *Injuries* happen in sports, but they multiply and exacerbate when players, egged on by ambitious coaches, take excessive risks for the extrinsic purpose of winning.
- 6. *Match fixing, gambling, bribery* and *corruption* are rarely for the love of the game.

Applications: How to Emphasize Intrinsic over Extrinsic Competition

In the gym, during classes and practice, and in friendly games, what may educators and coaches do to bring out the intrinsic aspects of sports and games? Attending to the intrinsics is easiest in the *informal* setting. Yet, to some extent, formal games can also be imbued with intrinsic enjoyment. Some suggestions follow.

- 1. *Emphasize immersion and doing one's best* to complete the rally successfully, and deemphasize winning points and games. Do not frame this as, "Participating is more important than winning," as this denigrates effort and competition per se. Participation without exertion is no ideal in sport.
- 2. Whenever aims, plans and hopes are discussed, they should *stress the intrinsics* of the game, not the extrinsics. When PE teachers and trainers talk sports they role-model, imparting priorities and values to young minds. Do we want to win on Saturday, or do we want to play a great game?

- 3. Off court, remind students and players how much fun and enjoyment actually arises from the intrinsic parts of their efforts. The exhilaration of shooting a long or difficult pass through the hoop is real, something in its own right. It signifies the struggle of one person against the constraints and the inertia of material reality. Rising to that challenge and doing great is wonderful in itself even when no one is around and no one may hear about it later. Remind young players to savor these experiences. Celebrate them and render them significant by verbalizing them at every turn.
- 4. Let the students play a game of basketball or volleyball *without keeping the score*. Take the game seriously and referee as if it were a formal game.
- 5. Mix several players across teams every five or 10 minutes—to forestall "us-them" jargon and to adjust relative team strengths. Say out loud that this is for the maximum enjoyment for all.
- 6. During the game or during time-outs, *praise the excellent pass or rally*, whether it produced a point or not. Emphasize courageous, innovative or playful (yet responsible) passes, especially in the build-up to an attack—and not just the point-scoring, final move.
- 7. Besides cooperative games, which are often appropriate in their own right, *adapt old games and invent new ones* that emphasize intrinsic cooperation. For example, the run-around table tennis game with six players: Do not play it with elimination, but count the number of fails produced, and seek to minimize that. Before starting, encourage players to play balls of optimal difficulty to whomever is standing across from them. Praise a player mid-game when that happens: "Nice, Kim, that was just right for Joe!"
- 8. Instead of dropping competitive sports or games because of large student disparities in skills, *change the rules or make other adjustments* to equalize skill levels. Assign weights, special obstacles, wearable handicaps, or playmaker roles to the better players. Before a volleyball game, tell students that clean passes will be required for only the most experienced players. Pass out weighted vests of different loads (1–10 lbs.) for each player, as you deem appropriate. The players need not know about their own or others'weights: "We're all different, on many parameters. What counts is that we give it all we've got."
- 9. Encourage players to acknowledge the opponents' best efforts after rallies. A "Well done!," or a pat or a hand extended to help an opponent get on their feet again may do a lot to ease the tension and remind both parties that they are here also for the shared pleasures of mutual challenge and physical exertion, and not just to deprive the opponent of a win.
- 10. Inform spectators at formal as well as friendly games about this distinction: "We focus on playing well, not merely on winning points and matches. Hence, be mindful of your cheering. Celebrate the precise pass, not just

"

Once the difference between intrinsic and extrinsic competition has been identified and named, the many negative effects of competitive sports may be rightly attributed to the urge to accumulate points, not to the enjoyment and excitement of the struggle between parties of comparable skill.

the goal. Encourage players' efforts and tenacity, not just their scoring. Acknowledge excellence by either team. Don't cheer opponents' mistakes. And we don't boo."

11. Invite parents to *take an interest in the intrinsics of their children's practice and games*, not just the extrinsics. The first question after practice should not be: "Did you win? How many points did you score?" Rather, ask about intrinsics first: "What did you enjoy at practice today? Do you remember one particularly great rally? What was your best contribution to the game? What was the most fun today? Did you talk to some of the

kids on the other team today? What was the nicest thing someone said to you during the game?"

12. Introduce the distinction between intrinsic and extrinsic competition, suitably paraphrased. Even children will understand words like these: "We play for two reasons: To have fun doing our best, and to win the game. If we do our best, we will always have fun, and sometimes we may even win. But those are two different things. The important thing is to fight with all we've got and have fun doing it. The second most important thing is to win points and games." Youths and adults will understand the technical terms intrinsic and extrinsic competition. They clarify what sport is about and may be useful in setting priorities in the sport domain and, possibly, in other aspects of life.

Conclusions

The distinction between intrinsic and extrinsic competition separates two *objective* phases in a ballgame and a duel: the rally, our general term for the extended period during which athletes struggle for successful completion, and the moment following that, when the winner is allocated a point. These two phases or aspects of a game or a duel may be accorded differential importance by those involved, implicating the *subjective* experiences of intrinsic and extrinsic *motivation*.

Once the difference between intrinsic and extrinsic competition has been identified and named, the many negative effects of competitive sports may be rightly attributed to the urge to accumulate points, not to the enjoyment and excitement of the struggle between parties of comparable skill. Few if any sports were designed with this distinction in mind, but practitioners and official committees may modify and develop them to bring out these psychologically sounder intrinsic aspects. Rules are being changed constantly, mostly to attract advertisers, but in minor leagues, pick-up games at the Y, physical education in schools, recreational games, and children's play the distinction may help reformers articulate this particular desideratum: "Intrinsic competition, please! Extrinsic, not so much."

Acknowledgments

Enlightening feedback for a manuscript version of this article from Glen Nielsen and Nina Tange is gratefully acknowledged.

References

- Alderman, B. L., Beighle, A., & Pangrazi, R. P. (2006). Enhancing motivation in physical education. *Journal of Physical Education, Recreation & Dance*, 77(2), 41–51. https://doi.org/10.1080/07303084. 2006.10597828.
- Beni, S., Fletcher, T., & Ní Chróinín, D. (2017). Meaningful experiences in physical education and youth sport: A review of the literature. *Quest*, 69(3), 291–312. https://doi.org/10.1080/0033629 7.2016.1224192

- Cardinal, B. J., Yan, Z., & Cardinal, M. K. (2013). Negative experiences in physical education and sport: How much do they affect physical activity participation later in life? *Journal of Physical Education, Recreation & Dance, 84*(3), 49–53. https://doi.org/10.1080/ 07303084.2013.767736.
- Choi, H. S., Johnson, B., & Kim, Y. K. (2014). Children's development through sports competition: Derivative, adjustive, generative, and maladaptive approaches. *Quest*, 66(2), 191–202. https://doi.org/ 10.1080/00336297.2013.861757.
- Crane, J., & Temple, V. (2015). A systematic review of dropout from organized sport among children and youth. *European Physical Education Review*, *21*(1), 114–131. https://doi.org/10.1177%2F13563 36X14555294.
- Currie, A. (2010). Sport and eating disorders—Understanding and managing the risks. *Asian Journal of Sports Medicine*, 1(2), 63–68. https://doi.org/10.5812/asjsm.34864
- Davies, B., Nambiar, N., Hemphill, C., Devietti, E., Massengale, A., & McCredie, P. (2015). Intrinsic motivation in physical education. *Journal of Physical Education, Recreation & Dance*, 86(8), 8–13. https://doi.org/10.1080/07303084.2015.1075922.
- Deci, E. L. (1975). Intrinsic motivation. Springer.
- Deci, E. L., & Ryan, R. M. (1985). Intrinsic motivation and self-determination in human behavior. Plenum Press.
- Duncan, C. A., & Kern, B. (2020) Getting competition under control. Journal of Physical Education, Recreation & Dance, 91(2), 33–41. https://doi.org/10.1080/07303084.2019.1693451.
- Dyson, B., Griffin, L. L., & Hastie, P. (2004). Sport education, tactical games, and cooperative learning: Theoretical and pedagogical considerations. *Quest*, 56(2), 226–240. https://doi.org/10.1080/003362 97.2004.10491823
- Elliott, E. S., & Dweck, C. S. (1988). Goals: An approach to motivation and achievement. *Journal of Personality and Social Psychology*, 54(1), 5–12. https://doi.org/10.1037/0022-3514.54.1.5.
- Gleddie, D. L. (2013). The minor hockey experience. Sport in Society, 16(3), 267–282. https://doi.org/10.1080/17430437.2013. 779855
- Jackson, S. A., & Csikszentmihalyi, M. (1999). Flow in sports. Human Kinetics.
- Harlow, H. F. (1950). Learning and satiation of response in intrinsically motivated complex puzzle performance by monkeys. *Journal* of Comparative and Physiological Psychology, 43(4), 289–294. https:// doi.org/10.1037/h0058114

- Harwood, C., Spray, C. M., & Keegan, R. (2008). Achievement goal theories in sport. In T. S. Horn (Ed.), *Advances in Sport Psychology* (pp. 157–185, 444–448). Human Kinetics.
- Kasser, T. (2016). Materialistic values and goals. Annual Review of Psychology, 67, 489–514. https://doi.org/10.1146/annurevpsych-122414-033344
- Mageau, G. A., & Vallerand, R. J. (2003). The coach-athlete relationship: A motivational model. *Journal of Sports Science*, 21(11), 883– 904. https://doi.org/10.1080/0264041031000140374.
- Nicholls, J. G. (1989). *The competitive ethos and democratic education*. Harvard University Press.
- Ntoumanis, N. (2001). Empirical links between achievement goal theory and self-determination theory in sport. *Journal of Sports Sciences*, 19(6), 397–409. https://doi.org/10.1080/026404101300149357
- Ntoumanis, N., & Standage, M. (2009). Motivation in physical education classes: A self-determination theory perspective. *Theory and Research in Education*, 7(2), 194–202. https://doi. org/10.1177/1477878509104324.
- Ryan, R. M., & Deci, E. L. (2017). Self-determination theory: Basic psychological needs in motivation, development, and wellness. Guilford Press.
- Uphill, M., Sly, D., & Swain, J. (2016). From mental health to mental wealth in athletes: Looking back and moving forward. *Frontiers in Psychology*, 7, 935. https://doi.org/10.3389%2Ffpsyg.2016.00935.
- Vallerand, R. J., Deci, E. L., & Ryan, R. M. (1987). Intrinsic motivation in sport. Exercise and Sport Sciences Reviews, 15(1), 389–426.
- Vallerand, R. J., Gauvin, L. I., & Halliwell, W. R. (1986). Effects of zero-sum competition on children's intrinsic motivation and perceived competence. *The Journal of Social Psychology*, 126(4), 465–472. https://doi/10.1080/00224545.1986.9713614.
- Vasconcellos, D., Parker, P. D., Hilland, T., Cinelli, R., Owen, K. B., Kapsal, N., Lee, J., Antczak, D., Ntoumanis, N., Ryan, R. M., & Lonsdale, C. (2020). Self-determination theory applied to physical education: A systematic review and meta-analysis. *Journal of Educational Psychology*, 112(7), 1444–1469. https://doi.org/10.1037/edu0000420.
- Visek, A. J., Achrati, S. M., Mannix, H. M., McDonnell, K., Harris, B. S., & DiPietro, L. (2015). The fun integration theory: toward sustaining children and adolescents sport participation. *Journal of Physical Activity and Health*, 12(3), 424–433. https://doi.org/10.1123%2Fjpah.2013-0180]

Ib Ravn (ravn@edu.au.dk) is an associate professor in the Graduate School of Education at Aarhus University in Copenhagen, Denmark.