

Evaluating ethical awareness of amateur athletes about disruptive sport technology: the case of Nike Vaporfly road running shoes

JORGE DE ANDRÉS-SÁNCHEZ¹, FERRAN DE TORRES-BURGOS², MARIO ARIAS-OLIVA³

¹ Business Management Department. Social and Business Research Laboratory. University Rovira i Virgili. SPAIN.

² Higher Education School Jaume I. SPAIN.

³ Marketing and Business Management Department. Complutense University of Madrid. SPAIN.

Published online: November 30, 2021

(Accepted for publication November 15, 2021)

DOI:10.7752/jpes.2021.s6438

Abstract:

Problem Statement: The development of Vaporfly technology (VFT), which was introduced by Nike in 2017, caused a disruption in long-distance running races. Using these shoes, an unexpected number of records in all standardized road distances have been broken. Scientific literature indicates that VFT improves performance, at least in highly trained athletes. This resulted in an extensive ethical discussion about the use of VFT in competitions and led to the development of a set of norms (which have been approved in 2020 by World Athletics) on the use of this technology. **Purpose:** This study analyses how ethical factors in multidimensional ethics scale (MES) developed by Shawver & Sennetti (2009) influence the acceptance of VFT shoes. The attitude is measured using the psychometrical scale proposed by Venkatesh & Davis (2000). **Approach:** Relations between variables have been fitted with a structural equation model, which has been adjusted with partial least squares. Thus, the influence of every explanatory variable on acceptance is measured with a so-called coefficient of the path (cp), whose value is within [-1, 1]. Its interpretation is analogous to that of a correlation coefficient. **Results:** We have determined that relativism (cp = 0.388, p < 0.01) and egoism (cp = 0.241, p < 0.01) are relevant ethical variables for explaining the acceptance of VFT. Likewise, moral equity (cp = 0.12, p = 0.262) and utilitarianism (cp = 0.098, p = 0.13) show a positive relation with attitude towards VFT. However, these relations are not significant at standard statistical levels. In addition, we have determined that contractualism shows a negative non-significant relation with intention to use. **Conclusions:** The influence of ethical factors on the intention to use a disruptive sport technology, such as the Nike Vaporfly running shoes, has been confirmed. Ethics explains almost 50% of the intention to use this technology.

Keywords: techno doping, disruptive technology, ethical judgements, multidimensional ethical scale, carbon plate shoes

Introduction

Breaking2 project in year 2017 and Ineos 1.59 challenge at 2019 were two outstanding events where a human, the Olympic marathon gold medal Eliud Kipchoge, tried to run a Marathon in less than 2 hours. Kipchoge finally attained that objective in Ineos 1.59 event. These sub 2h. challenges served to present Vaporfly technology (VFT) by Nike that had already been described in Hoogkamer et al. (2017). There is a great deal of academic literature showing that VFT enhances previous running shoe technologies (Hoogkamer et al. 2018b; Hunter et al., 2019; Hoogkamer, et al., 2019b; Barnes et al., 2019; Hunter et al., 2019). Statistical analyses of performances by elite and non-elite athletes in Quealy & Katz (2018), Guinness et al. (2020) and Bermon et al. (2021) show consistently that improvement due to VFT is statistically significant. Despite running performance improvements can be also linked to psychological factors (Christensen et al., 2018) in the opinion of some authors such as Muñoz-Pardos et al. (2021), enhancements by VFT are not only due to a placebo effect but are comparable to blood doping.

Among two key elements of the VFT, the carbon fibre plate and the new Zoom X foam, it was the plate that got principal attention. However, Hoogkamer et al. (2019b) and Burns & Tam (2019) indicate that more important than the effect of the carbon plate is that from its revolutionary foam. Despite being much thicker than conventional race shoes, Nike Vaporfly weighed substantially less than them. Until 2020, the World Athletics regulations ruled shoes only by stipulating a vague ban for those shoes that provide an unfair advantage and are not reasonably available in the market. This regulation, so fuzzy, in fact allowed the use and development of the VFT without restrictions.

Whenever a disruptive technological change occurs in a sport, there is a broad discussion about the ethics of its use (Dyer, 2015). A clear example is the controversial by Oscar Pistorius legs discussed in Dyer (2015) and Richard et al. (2020). Thus, a large part of the athletic community demanded a clear regulation of

VFT, which was qualified technological doping in several forums (Woodward, 2020; Ross, 2020). Some authors advocated for a regulation that may be understood within the ethical stream on sports tech that Loland (2002, 2009) labels as thick. So, Burns & Tam (2019) proposed regulating the thickness of the sole and Dyer (2020) suggested ensuring that certain issues such as that avoiding damage, denaturation or dehumanization of the sport or deskilling and reskilling were reasonably met. On the other hand, Muñiz-Pardos et al. (2021) by adopting the perspective on ethics that Loland (2002, 2009) considers thin claimed for its ban. This stream of opinion argues that the irruption of VFT does not allow a right measurement of athletic evolution (at an individual or a collective level) since the shoes used before 2017 are not equivalent to VFT shoes. The regulatory change that World Athletics introduced in 2020 must be understood within the thick theory of sports ethics (Torres-Burgos & Andrés-Sánchez, 2021). Even though VFT was not prohibited, its development and use was constrained. In spite of some authors feel this pragmatic regulation adequate (Dyer, 2020), this opinion is not unanimous. For example, Muñiz-Pardo et al. (2021) indicate that this decision is not consistent with that by World Athletics regarding 68 pins speed racing shoes that were banned at 1968 and world records broken with these shoes eliminated.

Ethical and moral evaluations have been proved significant to explain attitude towards novel techs in fields as electronic commerce (Leonard & Jones, 2017), education (Jung, 2009), or insideables (Reinares-Lara et al. 2018; Murata et al., 2019; Pelegrín-Borondo et al., 2020 and Olarte-Pascual et al., 2021). Graham & Burns (2020) have observed that ethical perceptions are also relevant to explain behaviour of collegiate athletes. Following this way, the objective of this paper is testing whether amateur athletes show ethical awareness in the decision on using VFT. To do this, we analysed a survey on 252 amateur athletes from Spain completed in March 2021. Explained variable, intention to use (IU) shoes with Vaporfly tech is measured with the psychometrical scale in Venkatesh & Davis (2000). Ethical awareness is quantified with the multidimensional ethical scale (MES) in Reidenbach & Robin (1990) extended by Shawver & Sennetti (2009). In this regard, Pelegrín-Borondo et al. (2020) and Olarte-Pascual et al. (2021) have shown that MES explains quite accurately the acceptance of new techs when they embed deep ethical concerns (in these papers, cyborg implants). All constructs and items used in the study are displayed in Table 1.

Multiple ethical scale in Shawver & Sennetti (2009) comprises following five constructs: moral equity, relativism, egoism, utilitarianism and contractualism. Moral equity (ME) is individual judgement on fairness, justice and what is correct and incorrect in the widest sense (Leonard et al., 2017). Olarte-Pascual et al. (2021) and Pelegrín-Borondo et al. (2020) outline that this dimension is significant to explain attitude towards insideables. Likewise in an education context (Jung, 2009) and in electronic commerce field (Leonard & Jones, 2017) this dimension has been found relevant.

Relativism (REL) is the perception about what is wrong and right within a social context (family, training mates, etc.). Jung (2009), Leonard & Jones (2017), Pelegrín-Borondo et al. (2020), Olarte-Pascual et al. (2021) report that a positive judgement in this ethical dimension is relevant to explain the acceptance of new techs. Often practitioners of endurance sports are members of communities and groups. For example, they belong to running clubs or online forums with a high engagement power (Littlejohns et al., 2019). So, Mahan III et al. (2015) show that social networks have a significant influence on running engagement and Ndayizigamiye et al. (2020) outline that the opinion of close persons is the most influential variable for the use of sport apps. Likewise, there are many magazines devoted to endurance sports with a great number of readers. So, it seems reasonable supposing that opinions in those media may influence the attitude towards VFT.

Egoism (EG) is the perception that adopting a decision promotes individual interest. It has been checked that VFT has allowed improving the performance of elite athletes (Guinness et al., 2020; Bermon et al., 2021). So, this dimension may explain why some of them opt to use Nive Vaporfly for achieving a better performance in a given competition that may lead them to be classified for example, to Olympic Games in spite of this decision may suppose losing their sponsoring shoe brand. In Spain we can outline the case of Olympic endurance runner Javier Guerra, which quit from Adidas to wear Nike Vaporfly in Sevilla marathon held at 2020 (Sánchez, 2020). In any case, not only professional athletes pretend optimizing sportive performance. Many amateur athletes may have also interest in obtaining as good performance as they can (Howgwei & Resza, 2021). Quealy & Katz (2018) show from Strava data that average performance of popular athletes improved with VFT.

Utilitarianism (UT) is the judgement that an action supposes a good for the society as a whole. It is clear that in elite/sub-elite these VFT shoes allow improving running performance (Dyer, 2020; Guinness et al., 2020; Muñiz-Pardos, 2021). VFT improves running economy due to the diminution of metabolic costs and also biomechanical changes in ankle (Hunter et al, 2017; Hoogkamer et al. 2017; Barnes & Kilding, 2019; Hoogkamer et al. 2019b). In addition spectacular events as Ineos 1.59 and Breaking2 have served to promote distance running (Torres-Burgos & Andrés-Sánchez, 2021). So, from the perspective on ethical “non-theory” exposed in Loland (2002, 2008) it seems that VFT are fully justified. Likewise, following arguments of Dyer (2020) and Torres-Burgos & Andrés-Sánchez (2021) it seems that its use must be judged positively from thick theory in Loland (2002). On the other hand, thin theory postulates that fully standardized equipment must be required to have an exact measure of performance improvement of athletes (Loland, 2002). Therefore, if thin ethical perspective is adopted, VFT must be judged negatively from utilitarianism dimension.

Often advances in running shoes tech reduce the risk of injuries (Vermeulen et al., 2021) that are due to intense musculoskeletal load produced by long distance competitions as, for example, half-marathon (Doyenart et al., 2020). Sailors (2009) link the expansion of running to the advances in shoe cushion. Prominent Spanish international endurance athletes reported faster muscular recoveries after intense sessions and competitions and also fewer injuries since they started using VFT (Jiménez, 2020). This argument allows perceiving VFT positively from utilitarianism perspective.

Contractualism (CT) judges the morality of an action in the context of perceived individual duties, implied contracts and/or underwritten obligations. So, it is clear that contractualism did not guide the decision of elite athletes Jesús España (New Balance athlete) and Lemawork Ketema (Adidas athlete) to compete with a pair of Vaporfly shoes that were tuned to face as their sponsoring brand shoes (Runnersworld, 2019). On the other hand, it has been documented in Spain by del Río et al. (2001) the existence of consumer loyalty to sport shoe brands. Thus it can be supposed that many runners may perceive their relation with a given brand as an “implied contract”.

To assess ethical awareness in VFT adoption we test following hypothesis:

- Hypothesis 1 (H1): A positive perception on moral equity influences positively attitude towards the use of VFT.
- Hypothesis 2 (H2): A positive perception on relativism influences positively attitude towards the use of VFT.
- Hypothesis 3 (H3): A positive perception on egoism influences positively attitude towards the use of VFT.
- Hypothesis 4 (H4): A positive perception on utilitarianism influences positively attitude towards the use of VFT.
- Hypothesis 5 (H5): A positive perception on contractualism influences positively attitude towards the use of VFT.

Table 1. Psychometrical scales used in this paper

Factor/construct	Source
Explained factor	
Intention to use (IU)	
IU1=I intend to employ VFT running shoes	Adapted from Venkatesh & Davis (2000)
IU2=I predict that I will employ VFT running shoes	
Explanatory constructs	
Moral equity	
ME1=unjust/just	
ME2= unfair/fair	
ME3= morally right/morally right	
Relativism	
RE1=Unacceptable/acceptable to my mates	
RE2=Unacceptable/acceptable from my athletic culture point of view	
RE3= Unacceptable/acceptable for people whose pinion I respect	
Egoism	
EG1=Not self promoting/promoting for me	
EG2=Not personally satisfying/personally satisfying for me	
Utilitarianism	
UT1=Useless/useful	
UT2=Maximizes cost and minimizes benefits/minimizes cost and maximizes benefits	
Contractualism	
CT1=Violates/does not violate an implied contract	
CT2=Violates/does not violate an implied promise	

Material and methods

Sample

In our study we use a survey answered by 252 Spanish amateur distance runners completed on-line within March 2021. Table 2 describes the sample in detail.

Table 2. Descriptive statistics and sample profile

Factor/construct	Mean	Median	SD	Q1	Q3	IV
Intention to use						
IU1	6.66	8	3.38	5	10	5
IU2	7.20	8	3.06	6	10	4
ME2	5.76	6	3.20	3	9	6
ME3	7.09	8	2.94	5	10	5
RE2	7.42	8	2.85	6	10	4

RE3	7.53	8	2.58	6	10	4
Egoism						
EG1	4.80	5	2.94	3	7	4
EG2	6.17	6	3.02	5	9	4
Utilitarianism						
UT1	6.81	7	2.74	5	9	4
UT2	5.72	6	2.86	3	8	5
Contractualism						
CT1	5.46	6	3.15	3	8	5
CT2	5.41	6	3.27	3	8	5
Composition by income	Monthly income \geq€2500 (47%)					
Composition by sex	86% men and 14% women					
Composition by sport	70% athletes and 30% triathletes					
Composition by dedication	59% athletes have license and 41% does not					
Composition by ages	15% are under 35 years; 42% between 35 and 45; 36% between 45 and 55; 6% were between 55 and 65 years and 1% were over 65 years.					

Note: SD is standard deviation, Q1 and Q3 are first and third quartile and ICV is interquartile variation, $ICV=Q3-Q1$

All questions were answered in an 11 level Likert scale (0, complete unfavourable perception to 10, complete favourable perception). Table 2 shows descriptive statistics of our survey. The mean/median responses show that VFT has an average evaluation above 5 in all the questions with the exception of “EG1=not self promoting/self promoting” whose mean (median) is slightly less than 5 (exactly 5).

Data analysis

We develop our analysis by using Structural Equation Modelling (SEM) that is fitted with Partial Least Squares (PLS) and Smart-PLS 3 software. As a first step we validate the scales by using accepted measures for convergent and discriminant validity of constructs. In a second step we adjust a SEM-PLS regression over IU that is explained by ethical constructs described above. By assessing determination coefficient R^2 we can measure the quality of adjustment whereas the predictive relevance is evaluated from Stone-Greiser cross-validated redundancy measure Q^2 (Hair et al, 2014).

Results

Results in Table 3 suggest that constructs present internal consistency. Cronbach’s alpha, composite reliability and ρ_A reach values above 0.7 and average variance extracted from items is above 0.5. However, it might be a doubt in the case of egoism. Its Cronbach alpha is slightly under 0.7 despite the values reached in other convergent validity measures met the required standard. However, notice that Cronbach’s alpha underrates a construct consistency whereas composite reliability overrates it (Hair et al., 2014). Likewise Cronbach’s alpha confidence interval for a significant level $\alpha=5\%$ is [0.559, 0.775].

Therefore, we can also accept internal consistency of egoism.

Matrix of divergent validity in Table 4 suggests that all constructs present discriminant power. The values of principal diagonal, that contain squared root of average variance extracted from items is above the correlations between factors.

Table 3. Convergent validity measures

Construct	Cronbach’s α	ρ_A	Composite reliability	Average variance extracted
Intention to use	0.906	0.908	0.955	0.914
Moral equity	0.932	0.968	0.956	0.879
Relativism	0.942	0.953	0.963	0.896
Egoism	0.667	0.878	0.845	0.734
Utilitarianism	0.730	0.730	0.881	0.788
Contractualism	0.938	0.942	0.970	0.942

Table 4. Matrix measuring divergent validity

	IU	ME	RE	EG	UT	CT
IU	0.956					
ME	0.622	0.938				
RE	0.661	0.876	0.947			
EG	0.575	0.580	0.599	0.857		
UT	0.530	0.561	0.584	0.730	0.887	
CT	0.482	0.580	0.595	0.709	0.674	0.970

Note: Principal diagonal is the squared root of the average variance extracted of the items of each construct. Above principal diagonal are indicated the correlations between constructs

Table 5 shows the following patterns in the coefficients of the paths:

- (1) Path coefficients present their hypothetical positive sign. The exception is contractualism. Whose coefficient is negative and not significantly different from 0. So, H5 is rejected.
- (2) Judgements on relativism ($cp=0.388$, $p<0.01$) and egoism ($cp=0.241$, $p<0.01$) present positive coefficients with a clear statistical significance. So, hypotheses H2 and H3 are accepted.
- (3) Although the sign of cp is as we expected for moral equity ($cp=0.120$, $p=0.262$) and utilitarianism ($cp=0.098$, $p=0.13$) it is not significantly different from 0 at standard statistical levels. So, hypotheses H1 and H4 are not confirmed.
- (4) The value of R^2 , which is close to 50%, informs that a moderate level of accuracy has been reached (Hair et al., 2014). Likewise, the value of $Q^2>0$ implies that our model has predictive capability (Hair et al., 2014).

Table 5. Results of the SEM-PLS estimates for the influence of ethical variables in intention to use VFT shoes

Effect	R^2	Q^2	Path coefficient (cp)	Student's t	p-value
	0.485	0.413			
ME -> IU			0.120	1.123	0.262
RE -> IU			0.388	3.534	0.000
EG -> IU			0.241	3.410	0.001
UT -> IU			0.098	1.517	0.130
CT -> IU			-0.056	0.800	0.424

Conclusions and further research

VFT has become a disruptive tech in endurance road running races. Academic literature shows that it improves athletic performance in approximately a 4%. So, their use by pro distance runners is nowadays very common. Likewise, literature also suggests that many amateur athletes could improve their performances by using VFT. These facts have stimulated ethical and philosophical debates on its use and have motivated this empirical assessment on the awareness by amateur athletes about competing with Vaporfly tech.

Results prove the influence of ethical perceptions on the intention to use a disruptive sport technology such as the Nike Vaporfly running shoes. These factors explain almost 50% of the attitude towards VFT. The main variable influencing the use of VFT is relativism, i.e. the social acceptability of that tech. In our context influence may come from the opinion of club mates, trainers, specialized journals, etc. The other relevant explanatory factor is egoism ($cp=0.241$, $p<0.01$). Likewise, we have also observed that positive perceptions on moral equity ($cp=0.120$) and utilitarianism ($cp=0.098$) influence positively IU VFT. However this fact has not a relevant statistical significance. We have also found a negative but not significant relation between contractualism and the acceptance of VFT.

These findings have important implications in the sport industry. Ethical aspects should be considered in the development of any disruptive technological innovation to make sure that a sport technology is acceptable by their potential users. Among the ethical factors, relativism is the most influential variable. The perception about what is correct within a social context is an essential variable influencing attitude towards a new sport technology. Individual ethical factor (egoism) is the second influential variable.

Despite MES has been applied to measure ethical awareness in the adoption of a disruptive technology in running shoes, we can also use this approach to assess ethical awareness about a different tech in any other discipline. Considering the pace of technological disruption, this study opens a new theoretical analysis framework. For example, wearables and insideables may allow acquiring superhuman capacities and skills and ethical concerns of this future technology on sport arena should require further analysis.

We are aware that the survey used in this paper has several limitations. However, these constraints may be an incentive for further research. The size of sample is adequate to obtain significant statistical results but it not excessively great. The proportion men/women is in accordance to rates in athletic competitions of Spain and also in studies on amateur distance running as Doyenart et al. (2020) and Hongwei & Resza (2021). However, we feel that a more balanced proportion would be preferable. Likewise this research is carried on by using a sample of amateur Spanish athletes. Conclusions might change if questionnaire were responded by runners from other geographical areas or by elite athletes. So, a wider study with different countries and comparative studies would be conducted. The survey has been developed after World Athletics ruled the use of VFT running shoes. It could be interesting making a longitudinal study of MES explanatory capability on disruptive sport tech acceptance by comparing the results before ruling that tech and those from the same study but after regulating it.

Funding details

Authors declare no funding.

Institutional Review Board Statement

With regard to ethics approval: (1) all participants were given detailed written information about the study and procedure; (2) no data directly or indirectly related to the subjects' health were collected and, thus, the Declaration of Helsinki was not generally mentioned when the subjects were informed; (3) the anonymity of the collected data was ensured at all times; and (4) no permission was obtained from a board or committee ethics approval, it was not required as per applicable institutional and national guidelines and regulations (5) voluntary completion of the questionnaire was taken as consent for the data to be used in research, informed consent of the participants was implied through survey completion.

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

Survey supporting the study can be obtained by demanding it to any author.

Conflicts of Interest

Authors declare having no conflicts of interest.

Authors Statement

Conceptualization: Jorge de Andrés-Sánchez and Ferran de Torres; Data curation: Jorge de Andrés-Sánchez; Formal analysis: Jorge de Andrés-Sánchez and Mario Arias-Oliva; Supervision: Mario Arias-Oliva; Writing and editing: All authors have contributed to the redaction of the paper.

References

- Barnes, K. R., & Kilding, A. E. (2019). A randomized crossover study investigating the running economy of highly-trained male and female distance runners in marathon racing shoes versus track spikes. *Sports Medicine*, 49(2), 331-342. <https://doi.org/10.1007/s40279-018-1012-3>.
- Bermon, S., Garrandes, F., Szabo, A., Berkovics, I., & Adami, P. E. (2021). Effect of advanced shoe technology on the evolution of road race times in male and female elite runners. *Frontiers in Sports and Active Living*, 3, 46. <https://doi.org/10.3389/fspor.2021.653173>.
- Burns, G. T., & Tam, N. (2020). Is it the shoes? A simple proposal for regulating footwear in road running. *British Journal of Sports Medicine*, 54, 4, 1-2. <http://dx.doi.org/10.1136/bjsports-2018-100480>
- Christensen, D. A., Brewer, B. W., & Hutchinson, J. C. (2018). Psychological predictors of performance in a 161 km ultramarathon run. *International Journal of Sport Psychology*, 49(1), 74-90. <https://doi.org/10.1023/A:1006140809998>.
- Del Rio, A. B., Vazquez, R., & Iglesias, V. (2001). The effects of brand associations on consumer response. *Journal of consumer marketing*. Vol. 18 No. 5, pp. 410-425. <https://doi.org/10.1108/07363760110398808>.
- Doyenart, R., Olímpio, M., Boeira, D., Sombrio, F., Milhomes, Y. P., Gomes, K. et al. (2020). Psychophysiological changes after a half marathon in amateur runners. *Journal of Physical Education and Sport*, 20(4), 1768-1774.
- Dyer, B. (2015). The controversy of sports technology: a systematic review. *SpringerPlus*, 4(1), 1-12. DOI: 10.1186/s40064-015-1331-x
- Dyer, B. (2020). A pragmatic approach to resolving technological unfairness: The case of Nike's Vaporfly and Alphafly running footwear. *Sports Medicine-Open*, 6, 1-10, <https://doi.org/10.1186/s40798-020-00250-1>.
- Graham, D. N., & Burns, G. N. (2020). Athletic Identity and Moral Development: An examination of collegiate athletes and their moral foundations. *International Journal of Sport Psychology*, 51(2), 122-140.
- Guinness, J., Bhattacharya, D., Chen, J., Chen, M., & Loh, A. (2020). An Observational Study of the Effect of Nike Vaporfly Shoes on Marathon Performance. arXiv preprint arXiv:2002.06105.
- Hair J.F., Sarstedt, M., Hopkins, L., Kuppelwieser, V.G. (2014). Partial least squares structural equation modeling (PLS-SEM): An emerging tool in business research. *European business review* 26(2), 106-121, <https://doi.org/10.1108/EBR-10-2013-0128>.
- Hongwei, Y., & Resza, A. M. (2021). Running motivations of non-elite long-distance runners in Indonesia. *Journal of Physical Education & Sport*, 21 (Suppl. issue 4), Art 291 pp 2288 – 2294.

- Hoogkamer, W., Kipp, S., & Kram, R. (2019b). The biomechanics of competitive male runners in three marathon racing shoes: a randomized crossover study. *Sports Medicine*, 49(1), 133-143, <https://doi.org/10.1007/s40279-018-1024-z>
- Hoogkamer, W., Kipp, S., Frank, J. H., Farina, E. M., Luo, G., & Kram, R. (2018b). A comparison of the energetic cost of running in marathon racing shoes. *Sports Medicine*, 48(4), 1009-1019. <https://doi.org/10.1007/s40279-017-0811-2>.
- Hoogkamer, W., Kram, R., & Arellano, C. J. (2017). How biomechanical improvements in running economy could break the 2-hour marathon barrier. *Sports Medicine*, 47(9), 1739-1750, <https://doi.org/10.1007/s40279-017-0708-0>.
- Hunter, I., McLeod, A., Valentine, D., Low, T., Ward, J., & Hager, R. (2019). Running economy, mechanics, and marathon racing shoes. *Journal of Sports Sciences*, 37(20), 2367-2373, <https://doi.org/10.1080/02640414.2019.1633837>.
- Jiménez, C. (2020). Los atletas españoles nos cuentan qué opinan sobre las polémicas zapatillas Vaporfly de Nike. *Runnersworld Magazine*. <https://www.runnersworld.com/es/zapatillas-correr-material-deportivo/a30671771/atletas-opinion-zapatillas-nike-vaporfly/>
- Jung, I. (2009). Ethical judgments and behaviors: Applying a multidimensional ethics scale to measuring ICT ethics of college students. *Computers & Education*, 53(3), 940-949. <https://doi.org/10.1080/10508422.2012.672907>.
- Leonard, L. N., Riemenschneider, C. K., & Manly, T. S. (2017). Ethical behavioral intention in an academic setting: Models and predictors. *Journal of Academic Ethics*, 15(2), 141–166. <https://doi.org/10.1007/s10805-017-9273-2>.
- Littlejohns, R., Gouthro, M. B., & Dickinson, J. (2019). Runners' engagement and social support practices: exploring the uses and role of online activities. *Sport in Society*, 22, 12, 2243-2260. <https://doi.org/10.1080/17430437.2019.1571486>.
- Loland, S. (2002). Technology in sport: Three ideal-typical views and their implications. *European Journal of Sport Science*, 2(1), 1-11, <https://doi.org/10.1080/17461390200072105>
- Loland, S. (2009). The ethics of performance-enhancing technology in sport. *Journal of the Philosophy of Sport*, 36(2), 152-161. <https://doi.org/10.1080/00948705.2009.9714754>
- Mahan III, J. E., Seo, W. J., Jordan, J. S., & Funk, D. (2015). Exploring the impact of social networking sites on running involvement, running behavior, and social life satisfaction. *Sport Management Review*, 18(2), 182-192, <https://doi.org/10.1016/j.smr.2014.02.006>.
- Muñiz-Pardos, B., Sutell, S., Angeloudis, K., Guppy, F. M., Bosch, A., & Pitsiladis, Y. (2021). Recent Improvements in Marathon Run Times Are Likely Technological, Not Physiological. *Sports Medicine*, 1-8, <https://doi.org/10.1007/s40279-020-01420-7>
- Murata, K., Arias-Oliva, M., & Pelegrín-Borondo, J. (2019). Cross-cultural study about cyborg market acceptance: Japan versus Spain. *European Research on Management and Business Economics*, 25(3), 129–137, <https://doi.org/10.1016/j.iedeen.2019.07.003>.
- Ndayizigamiye, P., Kante, M., & Shingwenyana, S. (2020). An adoption model of mHealth applications that promote physical activity. *Cogent Psychology*, 7(1), 1764703, <https://doi.org/10.1080/23311908.2020.1764703>.
- Olarte-Pascual, C.; Pelegrín-Borondo, J.; Reinares-Lara, E.; Arias-Oliva, M. (2021). From wearable to insideable: Is ethical judgment key to the acceptance of human capacity-enhancing intelligent technologies?. *Computers in Human Behavior*, 114, 106559, <https://doi.org/10.1016/j.chb.2020.106559>.
- Pelegrín-Borondo, J., Arias-Oliva, M., Murata, K., & Souto-Romero, M. (2020). Does ethical judgment determine the decision to become a cyborg?. *Journal of Business Ethics*, 161(1), 5-17, <https://doi.org/10.1007/s10551-018-3970-7>.
- Quealy, K.; Katz, K. (2018) Nike Says Its \$250 Running Shoes Will Make You Run Much Faster. What if That's Actually True? *The New York Times*. 8th July, 2018. <https://www.nytimes.com/interactive/2018/07/18/upshot/nike-vaporfly-shoe-strava.html>
- Reidenbach, R. E., & Robin, D. P. (1990). Toward the development of a multidimensional scale for improving evaluations of business ethics. *Journal of Business Ethics*, 9(8), 639–653. <https://doi.org/10.1007/BF00383391>.
- Reinares-Lara, E., Olarte-Pascual, C., & Pelegrín-Borondo, J. (2018). Do you want to be a cyborg? The moderating effect of ethics on neural implant acceptance. *Computers in Human Behavior*, 85(August), 43–53, <https://doi.org/10.1016/j.chb.2018.03.032>.
- Richard, R., Issanchou, D., & Ferez, S. (2020). Fairness, Regulation of Technology and Enhanced Human: A Comparative Analysis of the Pistorius Case and the Cyathlon. *Sport, Ethics and Philosophy*, 1-15. <https://doi.org/10.1080/17511321.2020.1818278>
- Ross, T. (2020). Running shoe tech: The Emperor's clothes, and the issues for the integrity of running. *The Science of Sport*, February 2020. <https://sportsscientists.com/2020/02/running-shoe-tech-the-emperors-clothes-and-the-issues-for-the-integrity-of-running/>

- Runner's World (2019). El plusmarquista austriaco de maratón también se pinta sus Nike Vaporfly de Adidas. May, 5th 2019. <https://www.runnersworld.com/es/noticias-running/a27401711/nike-vaporfly-adidas-pinta-zapatillas/>
- Sailors, P. R. (2009). More than a pair of shoes: Running and technology. *Journal of the Philosophy of Sport*, 36(2), 207-216. <https://doi.org/10.1080/00948705.2009.9714757>
- Sánchez, J. (2020). El gran éxito de Javi Guerra, el maratoniano que rompió con Adidas para poder correr con las 'mágicas' Vaporfly. *El Mundo*, February, 23th 2020. <https://www.elmundo.es/deportes/mas-deporte/2020/02/23/5e52b180fc6c83fb3f8b45f0.html>
- Shawver, T. J., & Sennetti, J. T. (2009). Measuring ethical sensitivity and evaluation. *Journal of Business Ethics*, 88(4), 663–678. <https://doi.org/10.1007/s10551-008-9973-z>.
- Torres Burgos, F., & Andrés-Sánchez, J. (2021). Vaporfly Tech in distance road running: some ethical concerns on its use and regulation [In Spanish]. *FairPlay, Revista de Filosofía, Ética y Derecho del Deporte*, (20), 68-89. <https://raco.cat/index.php/FairPlay/article/view/393497/486941>.
- Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the Technology Acceptance Model: Four longitudinal field studies. *Management Science*, 46, 186–204. <https://doi.org/10.1287/mnsc.46.2.186.11926>.
- Vermeulen, E., Grobbelaar, S. S., & Botha, A. (2021). Conceptualising a systems thinking perspective in sport studies. *Theoretical Issues in Ergonomics Science*, 22(2) 161-177. <https://doi.org/10.1080/1463922X.2020.1788662>.
- Woodward, A. (2020). Nike's controversial Vaporfly shoes are helping runners set new records, but some think it's 'technology doping.' Here's how they work. *Insider*, January 2020. <https://www.businessinsider.com/why-nike-vaporfly-shoes-make-runners-faster-2019-11>.