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Sieciowe podejście do uzależnienia od pracy oraz uzależnienia od nauki

Network Approach to Work Addiction and Study Addiction

Rozprawa doktorska napisana pod kierunkiem

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Streszczenie

Praca oraz nauka są jednymi z najważniejszych czynności w ludzkim życiu i mają na nie zdecydowanie pozytywny wpływ. Jednakże w przypadku niewielkiej grupy ludzi oddawanie się tym czynnościom może prowadzić do rozwoju uzależnienia, które przekłada się na ogólne pogorszenie funkcjonowania jednostki. Pomimo licznych badań etiologia uzależnienia od pracy i jego wczesnej formy, uzależnienia od nauki, w dalszym ciągu nie jest w pełni poznana. W niniejszej rozprawie doktorskiej starałem się przyczynić do lepszego jej zrozumienia poprzez wykorzystanie sieciowej teorii zaburzeń psychicznych do skonceptualizowania uzależnienia od pracy i uzależnienia od nauki jako dynamicznych systemów symptomów. Sieciowa teoria zaburzeń psychicznych opiera się na założeniu, że pomiędzy symptomami mogą istnieć bezpośrednie związki odpowiedzialne za powstawanie i utrzymywanie się zaburzeń, a ich identyfikacja jest niezbędna do planowania skutecznych oddziaływań terapeutycznych i prewencyjnych. Ponadto istotnym elementami tych interwencji mogą być również bezpośrednie związki pomiędzy symptomami zaburzenia i innymi zjawiskami. W ramach niniejszej rozprawy doktorskiej zbadane zostały bezpośrednie związki pomiędzy symptomami uzależnienia od pracy, wymiarami zaangażowania w pracę, wymiarami wypalenia zawodowego oraz wymiarem postrzeganego stresu, a także bezpośrednie związki pomiędzy symptomami uzależnienia od nauki oraz wymiarami zaangażowania w naukę. W tym celu do oszacowania 12 Gaussowskich modeli grafowych wykorzystane zostały zbiory danych zastanych pochodzące z trzech wcześniej przeprowadzonych badań, w których łączna liczba zbadanych osób wynosiła $N = 19\ 028$. Uzyskane wyniki wskazują, że wzorce bezpośrednich związków pomiędzy symptomami uzależnienia od pracy oraz symptomami uzależnienia od nauki były niemal identyczne. W obu przypadkach zidentyfikowane zostały dwa klastry symptomów przypominające podział na bardziej (tolerancja, nawrót, konflikt i

problemy) i mniej (istotność, modyfikacja nastroju i symptomy odstawienne) patologiczne symptomy uzależnienia. Ponadto w obu przypadkach kluczową rolę w połączeniu uzależnienia z zaangażowaniem odgrywały modyfikacja nastroju (symptom uzależnienia) oraz zaabsorbowanie (wymiar zaangażowania). Na podstawie modelu, w którym poza symptomami uzależnienia od pracy i wymiarami zaangażowania w pracę zawarte zostały również wymiary wypalenia zawodowego oraz wymiar postrzeganego stresu, bezpośrednie związki pomiędzy uzależnieniem od pracy i pozostałymi zjawiskami psychologicznymi udało się ograniczyć do czterech. Były to związki pomiędzy (1) modyfikacją nastroju i zaabsorbowaniem, (2) modyfikacją nastroju i stresem, (3) symptomami odstawiennymi i stresem oraz (4) problemami i wyczerpaniem. W konsekwencji w ramach niniejszej rozprawy doktorskiej zaproponowane zostały trzy oddziaływania prewencyjno-terapeutyczne, które zgodnie z sieciową teorią zaburzeń psychicznych mogą skutecznie zahamować proces odpowiedzialny za uzależnienie. Po pierwsze, kluczowym wydaje się uświadamianie jednostek, że pozytywne zaabsorbowanie pracą lub nauką może współwystępować z uzależnieniem, a skuteczne zidentyfikowanie tego drugiego wymaga skupienia się na pojawiających się negatywnych konsekwencjach pracy lub nauki. W drugiej kolejności należy edukować jednostki, że zamiast uciekać od problemów w pracę lub naukę mogą stosować adaptacyjne strategie radzenia sobie ze stresem. Wreszcie, należy uświadamiać jednostki, że regularne przepracowywanie się lub przeuczanie się nie tylko pogarsza ich wydajność, ale może prowadzić również do bardzo poważnych konsekwencji zdrowotnych.

Słowa kluczowe: uzależnienie od pracy, pracoholizm, uzależnienie od nauki, analiza sieci, sieciowe podejście do zjawisk psychologicznych, sieciowa teoria zaburzeń psychicznych, gaussowski model grafowy

Abstract

Work and study are among the most important activities in human life and definitively have a positive impact on it. However, in the case of a small group of people, involvement in these activities may lead to the development of addiction, which leads to a general deterioration of the individual's functioning. Despite numerous studies, the etiology of work addiction and its early form, study addiction, is still not fully understood. In this dissertation, I have sought to contribute to a better understanding of this etiology by using the network theory of mental disorders to conceptualize work addiction and study addiction as dynamic systems of symptoms. The network theory of mental disorders is based on the assumption that there may be direct relationships between symptoms that are responsible for the development and maintenance of disorders, and their identification is necessary to plan effective therapeutic and preventive interventions. Moreover, direct relationships between the symptoms of the disorder and other phenomena may also be important elements of these interventions. This doctoral dissertation examined the direct relationships between the symptoms of work addiction, the dimensions of work engagement, the dimensions of burnout, and the dimension of perceived stress, as well as the direct relationships between the symptoms of study addiction and the dimensions of work engagement. For this purpose, secondary data sets from three previously conducted studies were used to estimate 12 Gaussian graphical models, in which the total number of people examined equaled $N = 19{,}028$. The obtained results indicate that the patterns of direct relationships between the symptoms of work addiction and the symptoms of study addiction were almost identical. In both cases, two clusters of symptoms were identified, resembling a division into more (tolerance, relapse, conflict, and problems) and less (salience, mood modification, and withdrawal) pathological symptoms of addiction. Moreover, in both cases, mood modification (a symptom of addiction) and absorption (a dimension of

engagement) played a key role in connecting addiction and engagement. Based on the model, which, in addition to the symptoms of work addiction and work engagement dimensions, also included the dimensions of burnout and the dimension of perceived stress, direct relationships between work addiction and other psychological phenomena were limited to four. These were the associations between (1) mood modification and absorption, (2) mood modification and stress, (3) withdrawal and stress, and (4) problems and exhaustion. Consequently, this doctoral dissertation proposes three preventive and therapeutic interventions which, in accordance with the network theory of mental disorders, can effectively inhibit the process responsible for addiction. Firstly, it seems crucial to make individuals aware that positive absorption by work or study may co-occur with addiction, and that effectively identifying the latter requires focusing on the emerging negative consequences of work or study. Secondly, individuals should be educated that instead of escaping from problems into work or study, they can use adaptive strategies to cope with stress. Finally, individuals should be made aware that regular overwork or overstudying not only impairs their performance but may also lead to very serious health consequences.

Keywords: work addiction, workaholism, study addiction, network analysis, network approach to psychology, network theory of mental disorders, Gaussian graphical model

Spis treści

1. Wprowadzenie do autoreferatu

Niniejszy autoreferat stanowi wprowadzenie do pracy doktorskiej w formie cyklu artykułów. Cykl podejmuje zagadnienie konceptualizacji uzależnienia od pracy oraz jego wczesnej formy, uzależnienia od nauki, jako dynamicznych systemów symptomów zgodnych z sieciową teorią zaburzeń psychicznych (Borsboom, 2017). W skład cyklu wchodzą następujące prace:

ARTYKUŁ 1. Bereznowski, P., Atroszko, P. A., Konarski, R. (2024). Network approach to work addiction: A cross-cultural study. *SAGE Open*, *14*(2), 1–16. https://doi.org/10.1177/21582440241245414

KOMENTARZ: IF = 2,0. 70 pkt. MNiSW. Indywidualny wkład procentowy: 60%.

ARTYKUŁ 2. Bereznowski, P., Bereznowska, A., Atroszko, P. A., Konarski, R. (2023). Work addiction and work engagement: A network approach to cross-cultural data. *International Journal of Mental Health and Addiction*, *21*, 2052–2076. https://doi.org/10.1007/s11469-021-00707-8

KOMENTARZ: IF = 8,0. 40 pkt. MNiSW. Indywidualny wkład procentowy: 60%.

ARTYKUŁ 3. Bereznowski, P., Atroszko, P. A., Konarski, R. (2023). Work addiction, work engagement, job burnout, and perceived stress: A network analysis. *Frontiers in Psychology*, *14*, artykuł 1130069. https://doi.org/10.3389/fpsyg.2023.1130069

KOMENTARZ: IF = 3,8. 70 pkt. MNiSW. Indywidualny wkład procentowy: 50%.

ARTYKUŁ 4. Bereznowski, P., Konarski, R., Pallesen, S., Atroszko, P. A. (2024). Similarities and differences between study addiction and study engagement and work addiction and work

engagement: A network analysis. *International Journal of Mental Health and Addiction*. https://doi.org/10.1007/s11469-023-01234-4

KOMENTARZ: IF = 8,0. 40 pkt. MNiSW. Indywidualny wkład procentowy: 35%.

Cykl został w całości sfinansowany w ramach siódmej edycji programu „Diamentowy Grant" prowadzonego przez Ministerstwo Nauki i Szkolnictwa Wyższego (numer projektu: DI 2017 001247; kierownik projektu: mgr Piotr Bereznowski).

Przedstawiony cykl opisuje wyniki analizy danych zastanych pochodzących z trzech wcześniej przeprowadzonych badań. Pierwsze badanie miało charakter poprzeczny i było przeprowadzone w roku 2014 na grupie 16 426 osób pracujących, pochodzących z norweskiej populacji ogólnej (Andreassen i in., 2016; **GRUPA 1**). Drugie badanie miało charakter poprzeczny i było przeprowadzone w latach 2014–2016 na grupie 723 osób pracujących, pochodzących z polskiej populacji ogólnej (Atroszko i in., 2017; **GRUPA 2**). Trzecie badanie miało charakter podłużny, pierwsza fala badania miała miejsce w roku 2013 na grupie 2 559 osób studiujących, pochodzących z norweskiej populacji studentów (**GRUPA 3**) oraz 2 177 osób studiujących, pochodzących z polskiej populacji studentów (**GRUPA 4**), które to w kolejnych falach badania stopniowo stawały się osobami pracującymi (Atroszko i in., 2016). Cztery grupy zostały wybrane tak, żeby różniły się między sobą narodowością oraz czynnikami socjodemograficznymi, dzięki czemu możliwe było zmaksymalizowanie trafności zewnętrznej przeprowadzonych badań. Tabela 1 prezentuje, z których grup pochodziły dane przeanalizowane w poszczególnych artykułach, a także informuje o liczbie obserwacji pochodzących z każdej z grup. W przypadku **GRUPY 3** i **GRUPY 4** tabela 1 dodatkowo informuje, z której fali badania pochodziły zebrane dane oraz czy pochodziły one od osób

pracujących, czy też uczących się (u osób pracujących mierzone były zjawiska dotyczące pracy, a u osób uczących się zjawiska dotyczące nauki).

Tabela 1

Liczba obserwacji z poszczególnych grup analizowanych w artykułach zawartych w cyklu

Grupa	Populacja	Kraj	Artykuł 1	Artykuł 2	Artykuł 3	Artykuł 4
1	Ogólna	Norwegia	16 426	—	—	—
2	Ogólna	Polska	719	701	676	—
3	Młodzi dorośli	Norwegia	764[a]	755[a]	—	1107[b]
4	Młodzi dorośli	Polska	711[a]	697[a]	—	776[b]

[a] Dane pochodzące od osób pracujących w trakcie trzeciej fali badania podłużnego (w roku 2016). [b] Dane pochodzące od osób uczących się w trakcie drugiej fali badania podłużnego (na przełomie lat 2014 i 2015).

Kamieniem węgielnym całego cyklu jest **ARTYKUŁ 1**, w którym analiza teoretycznych i empirycznych przesłanek za zasadnością zastosowania sieciowej teorii zaburzeń psychicznych stanowi przyczynek do przeanalizowania bezpośrednich związków pomiędzy symptomami uzależnienia od pracy. O ile bezpośrednie związki pomiędzy symptomami są centralnym elementem sieciowej teorii zaburzeń psychicznych (Borsboom, 2017), tak do pełnego zrozumienia procesu odpowiedzialnego za uzależnienie od pracy niezbędnym jest poznanie również bezpośrednich związków symptomów z innymi zjawiskami pełniącymi rolę czynników ryzyka oraz negatywnych konsekwencji uzależnienia. Z tego powodu, model oszacowany w **ARTYKULE 1** zostaje następnie rozszerzony w **ARTYKULE 2** o wymiary zaangażowania w pracę, a w **ARTYKULE 3** o wymiary wypalenia zawodowego i wymiar postrzeganego stresu. W konsekwencji, możliwym staje się nie tylko uchwycenie procesu zachodzącego pomiędzy symptomami uzależnienia od pracy, ale również osadzenie go w szerszym kontekście, który umożliwia planowanie bardziej skutecznych oddziaływań terapeutycznych i prewencyjnych. Wreszcie **ARTYKUŁ 4**, w którym przeanalizowane zostały

związki pomiędzy symptomami uzależnienia od nauki i wymiarami zaangażowania w naukę, stanowi próbę porównania procesu uzależnienia od nauki z procesem uzależnienia od pracy zaprezentowanym w **ARTYKULE 1** i **ARTYKULE 2**. Tym samym cały cykl stanowi zamkniętą całość, w ramach której sieciowa teoria zaburzeń psychicznych została wykorzystana do kompleksowego uchwycenia procesu uzależnienia zarówno na etapie edukacji jak i na etapie pracy zawodowej.

Dalsza część niniejszego autoreferatu składa się z dwóch rozdziałów. Pierwszy z rozdziałów dedykowany jest wprowadzeniu teoretycznemu, które zawiera podrozdział dotyczący pracy i nauki oraz związanych z nimi zjawisk psychologicznych (**PODROZDZIAŁ 2.1**), a także podrozdział dotyczący sieciowego podejścia do zjawisk psychologicznych (**PODROZDZIAŁ 2.2**). W **PODROZDZIALE 2.1** przedstawię szersze rozumienie pracy i nauki — czynności życia codziennego, które w przypadku poświęcenia na nie zbyt dużej ilości czasu i energii mogą doprowadzić do pogorszenia fizycznego i psychicznego funkcjonowania jednostki. Następnie omówię powiązane z nimi zjawiska, badane w ramach prezentowanego cyklu artykułów, oraz najważniejsze związki pomiędzy nimi. W **PODROZDZIALE 2.2** przedstawię sieciową teorię zaburzeń psychicznych (Borsboom, 2017) wraz z jej założeniami oraz omówię model statystyczny wykorzystany w artykułach zawartych w cyklu (tj. Gaussowski model grafowy).

Drugi z rozdziałów dedykowany jest badaniom własnym. W tym rozdziale zaprezentuję najważniejsze pytania badawcze, które stanowiły wyjście do przeprowadzonych badań (**PODROZDZIAŁ 3.1**), dokonam syntezy wyników (**PODROZDZIAŁ 3.2**) oraz płynących z nich wniosków i implikacji praktycznych (**PODROZDZIAŁ 3.3**), a także przedstawię mocne strony i

ograniczenia przeprowadzonych analiz, oraz możliwe kierunki przyszłych badań (**PODROZDZIAŁ 3.4**).

2. Wprowadzenie teoretyczne

2.1 Praca i nauka oraz związane z nimi zjawiska psychologiczne

Praca jest jedną z najważniejszych czynności w ludzkim życiu, zarówno pod względem poświęcanego na nią czasu, jak i jej konsekwencji dla życia jednostki. Po pierwsze dzięki otrzymywanemu wynagrodzeniu, jednostka może zaspokajać najbardziej podstawowe potrzeby własne oraz najbliższych, takie jak pożywienie, odzież oraz miejsce do życia. Poza tym praca nadaje rytm dniom i tygodniom jednostki, a także pozwala poznawać nowych ludzi, rozwijać umiejętności, budować poczucie przynależności oraz odczuwać, że jest się szanowanym, respektowanym, i/lub rozpoznawanym (Maslow, 1943). Tym samym praca nie tylko odgrywa ważną rolę w procesie budowania tożsamości jednostki (Doherty, 2009), ale także możne nadawać sens i znaczenie jej życiu (Ward i King, 2017). Co więcej, praca pozytywnie wpływa na dobrostan psychologiczny jednostek oraz stanowi czynnik ochronny przeciw zaburzeniom psychicznym (Modini i in., 2016), a postrzeganie przez jednostkę własnej pracy jako mającej znaczenie współwystępuje z szeregiem pozytywnych zjawisk zarówno w życiu zawodowym (np. silniejsze zaangażowanie w pracę, silniejsza satysfakcja z pracy oraz słabsze wypalenie zawodowe), jak i w życiu prywatnym (np. silniejsze poczucie własnej skuteczności oraz lepsze zdrowie; Allan i in., 2019).

Liczba godzin pracy w pełnym wymiarze godzinowym waha się w krajach europejskich w okolicach 40 godzin tygodniowo (Eurostat, 2018). Jednakże średnia liczba godzin poświęcanych przez Europejczyków na pracę jest często niższa z powodu dużego udziału zatrudnienia w niepełnym wymiarze godzin, szczególnie w krajach o wysokim produkcie krajowym brutto, takich jak Holandia, Niemcy lub Norwegia (Eurostat, 2022; Lee i in., 2007). W roku 2021 w krajach europejskich średnio poświęcano na pracę od 33,2 do 41,0 godzin

tygodniowo (Eurostat, 2023a). Krótsze średnie godziny pracy były charakterystyczne dla obywateli państw Europy Zachodniej, takich jak Holandia, Niemcy lub Norwegia, a dłuższe dla obywateli państw Europy Wschodniej, takich jak Polska, Rumunia, Bułgaria lub Grecja (Eurostat, 2023b). Jednocześnie z szacunków Eurostatu (2023b) wynika, że 7% Europejczyków regularnie poświęcało na pracę zawodową ponad 49 godzin tygodniowo, a odsetek ten różnił się w zależności od kraju i wynosił od 10,2% we Francji, przez 7,9% w Polsce i 4,9% w Norwegii, do 0,7% w Bułgarii. Są to o tyle alarmujące statystyki, że zgodnie z szacunkami Światowej Organizacji Zdrowia oraz Międzynarodowej Organizacji Pracy, długie godziny pracy (w tym konkretnym badaniu zoperacjonalizowane jako 55 godzin pracy tygodniowo lub więcej) przekładają się na choroby układu krążenia, które w konsekwencji każdego roku doprowadzają do około 745 tysięcy zgonów w skali całego świata (Pega i in., 2021). Ponadto badania naukowe wskazują, że długie godziny pracy mogą przyczyniać się do pogorszenia funkcjonowania jednostki w kwestiach zdrowia fizycznego, psychicznego i społecznego (Bannai i Tamakoshi, 2014; Kivimäki, Jokela, i in., 2015; Kivimäki, Virtanen, i in., 2015; Michel i in., 2011; Michel i in., 2013; Virtanen i in., 2015). Tym samym dane wskazują, że korzyści płynące z oddawania się przez jednostkę pracy zawodowej mogą zostać przeważone przez szkody powstające, gdy jednostka regularnie pracuje zbyt długo.

Motywacja do zbyt intensywnej i długotrwałej pracy może wynikać z sytuacji, w jakiej osoba się znajduje (np. trudnej sytuacji materialnej) lub wewnętrznej skłonności do takiego zachowania (np. odczuwania kompulsywnego przymusu pracy), która rozwija się na przestrzeni całego życia (Snir i Harpaz, 2012). Biorąc pod uwagę, że u dzieci, młodzieży i młodych dorosłych nauka pełni rolę podobną do pracy, zasadna wydaje się hipoteza, że skłonność do inwestowania dużej ilości czasu i wysiłku w pracę może rozwijać się już od najmłodszych lat. W literaturze psychologicznej można zaobserwować, że badacze często

bardzo podobnie konceptualizują i operacjonalizują zjawiska psychologiczne związane z pracą i nauką, niejako zakładając, że procesy psychiczne towarzyszące pracy i nauce są tożsame (Atroszko i in., 2015; Schaufeli i Bakker, 2004; Walburg, 2014).

Należy jednak pamiętać, że traktowanie pracy i nauki jako całkowicie tożsamych może stanowić zbyt duże uproszczenie. Gratyfikacja za naukę ma charakter bardziej abstrakcyjny oraz odroczony niż samo otrzymywanie wynagrodzenia. W konsekwencji w wielu przypadkach jednostka może zaobserwować realne oddziaływanie nauki na własne życie dopiero po latach, a nie po kilku tygodniach, jak w przypadku pracy. Warto również zauważyć, że w roku 2017 w Unii Europejskiej aż 42% osób pracowało w zawodach wymagających użycia siły (30% w zawodach wymagających umiarkowanej ilości siły — np. kelner; 12% w zawodach wymagających dużej ilości siły — np. pracownik budowlany; Eurostat, 2019). Tym samym wiele Europejczyków wykonuje skrajnie inne aktywności w ramach pracy i nauki, co może oznaczać, że ich funkcjonowanie w trakcie edukacji niekoniecznie musi przekładać się na funkcjonowanie w pracy. Co więcej, nawet osoby pracujące umysłowo na etapie edukacji były zmuszone zdobywać wiedzę i umiejętności z wielu różnorodnych dziedzin, również tych, do których nie miały predyspozycji, czy wykraczających daleko poza ich zainteresowania. Obszary te ulegały stopniowemu zawężaniu na kolejnych etapach edukacji. Jednak dopiero na etapie studiów wyższych zaczęły się one bezpośrednio pokrywać się z wiedzą i umiejętnościami wymaganymi w ich potencjalnym przyszłym zawodzie. Co za tym idzie, również w przypadku osób pracujących umysłowo profil aktywności podejmowanej w ramach pracy i nauki nie zawsze jest tożsamy, więc mechanizmy wzmagające motywację również mogą być różne.

W niniejszej rozprawie doktorskiej skupiam się na badaniu procesów psychologicznych związanych zarówno z pracą, jak i nauką. Centralne miejsce wśród badanych zjawisk zajmuje

uzależnienie, a towarzyszą mu zaangażowanie, wypalenie oraz stres. W dwóch kolejnych podrozdziałach pokrótce przedstawię każde z tych zjawisk oraz nakreślę związki pomiędzy nimi. W pierwszej kolejności opiszę zjawiska związane z pracą, będące przedmiotem zainteresowania w **ARTYKUŁACH 1**, **2** i **3** (uzależnienie od pracy, zaangażowanie w pracę, wypalenie zawodowe oraz postrzegany stres). Następnie omówię zjawiska związane z nauką będące przedmiotem zainteresowania w **ARTYKULE 4** (uzależnienie od nauki i zaangażowanie w naukę).

2.1.1 Uzależnienie od pracy, zaangażowanie w pracę, wypalenie zawodowe oraz postrzegany stres

Uzależnienie od pracy (często również nazywane pracoholizmem) jest w niniejszej pracy badane w paradygmacie uzależnień behawioralnych, w którym definiowane jest następująco:

> Uzależnienie od pracy charakteryzuje się kompulsją pracy oraz obsesją czynnościami związanymi z pracą prowadzącymi do istotnej szkody i dystresu o charakterze funkcjonalnie upośledzającym daną osobę i/lub inne istotne relacje (z przyjaciółmi i rodziną). Zachowanie to charakteryzuje się utratą kontroli nad wykonywaną pracą i utrzymuje się przez znaczny okres czasu. To problematyczne zachowanie związane z pracą może mieć różną intensywność, od łagodnej do ciężkiej. Utrata kontroli nad aktywnością zawodową obejmuje pracę w większym wymiarze niż zaplanowany, pomimo negatywnych konsekwencji i/lub nieudanych prób ograniczenia aktywności i/lub stopniowego wydłużania czasu poświęcanego na pracę. Symptomy odstawienne (w tym drażliwość, negatywne uczucia, problemy ze snem itp.) są częste, jeśli planowana/pożądana ilość pracy jest utrudniona lub pojawiają się, gdy podejmowane

są próby zmniejszenia ilości pracy. Aktywność zawodowa często służy zmniejszeniu negatywnych uczuć i/lub uniknięciu konfliktów interpersonalnych i/lub intrapersonalnych. (Atroszko i in., 2019, s. 9)

Zgodnie z powyższą definicją oraz biopsychospołecznym modelem uzależnień behawioralnych (Brown, 1993; Griffiths, 2005), wśród symptomów, których mogą doświadczać osoby uzależnione od pracy, znajdują się: (1) istotność, (2) tolerancja, (3) modyfikacja nastroju, (4) nawrót, (5) symptomy odstawienne, (6) konflikt oraz (7) problemy wynikające z nadmiernego oddawania się pracy. *Istotność* (1) odnosi się do stałego skupienia na pracy, które manifestuje się w dominacji pracy w myślach, uczuciach i zachowaniach osoby. *Tolerancja* (2) odnosi się do potrzeby zwiększania ilości pracy w celu osiągnięcia wcześniejszych efektów modyfikowania nastroju oraz do stopniowego zwiększania ilości czasu poświęcanego na pracę każdego dnia. *Modyfikacja nastroju* (3) odnosi się do subiektywnego odczucia, że pracowanie umożliwia ucieczkę od przeżywanych negatywnych stanów, które jednostka odczuwa (takich jak np. lęk, poczucie winy lub poczucie beznadziejności) lub też do odczuwania pobudzenia przypominającego narkotykowy „high" w trakcie pracy. *Nawrót* (4) odnosi się do wielokrotnego powrotu do wcześniejszych wzorców przepracowywania się (nawet w przypadku ich najbardziej skrajnych form) po okresach kontroli, w których to jednostka pracuje w sposób powszechnie postrzegany za normę. *Symptomy odstawienne* (5) odnoszą się do nieprzyjemnych przeżyć emocjonalnych oraz/lub fizycznych odczuć, które jednostka odczuwa, gdy z jakiegoś powodu nie może w danym momencie pracować. *Konflikt* (6) odnosi się zarówno do konfliktów pomiędzy osobą uzależnioną a innymi osobami z jej rodziny lub kręgu znajomych, jak i do konfliktu pomiędzy pracą i innymi aktywnościami takimi jak życie społeczne lub hobby, a także do wewnątrzpsychicznego konfliktu dotyczącego niekompatybilności potrzeb. *Problemy* (7)

odnoszą się do wszelkiego rodzaju problemów (zazwyczaj zdrowotnych), jakie są efektem przepracowywania się przez jednostkę (Andreassen i in., 2012; Griffiths, 2011; Griffiths i in., 2018).

Bliźniaczym konstruktem wobec uzależnienia od pracy jest zaangażowanie w pracę. Oba zjawiska są klasyfikowane jako podtypy intensywnego inwestowania w pracę, które różnią się konsekwencjami — pozytywnymi dla zaangażowania i negatywnymi dla uzależnienia (Di Stefano i Gaudiino, 2019; Snir i Harpaz, 2012; Lee i in., 2022). W niniejszej pracy wykorzystałem najpopularniejszą i najlepiej przebadaną konceptualizację zaangażowania w pracę, zgodnie z którą zjawisko to jest definiowane jako stan psychiczny związany z pracą, charakteryzujący się trzema wymiarami: (1) wigorem, (2) oddaniem się pracy i (3) zaabsorbowaniem (Schaufeli, Bakker, Salanova, 2006; Schaufeli, Salanova i in., 2002). Wigor (1) odnosi się do "wysokiego poziomu energii i odporności psychicznej podczas pracy, chęci inwestowania wysiłku w swoją pracę i wytrwałości nawet w obliczu trudności" (Schaufeli i in., 2002, s. 74). Oddanie się pracy (2) definiowane jest jako "poczucia znaczenia, entuzjazmu, inspiracji, dumy i wyzwania" (Schaufeli i in., 2002, s. 74). Zaabsorbowanie (3) określa "bycie w pełni skoncentrowanym i głęboko pochłoniętym swoją pracą, przy czym czas mija szybko i trudno jest oderwać się od pracy" (Schaufeli i in., 2002, s. 75).

Szczególnie ważną rolę w różnicowaniu uzależnienia od pracy i zaangażowania w pracę odgrywa stres. Związek stresu z uzależnieniem od pracy jest pozytywny, a z zaangażowaniem w pracę negatywny (Clark i in., 2016; Mazzetti i in., 2023). Co ważne, jest on nie tylko negatywną konsekwencją uzależnienia od pracy, ale również jego przyczyną, ponieważ uzależnienie jest nieadaptacyjnym mechanizmem radzenia sobie z nadmiernym stresem (Jacobs, 1986; zob. też: Ruisoto i Contador, 2019). W konsekwencji powstaje błędne koło, w którym stres i uzależnienie wzajemnie się napędzają, jednocześnie przyczyniając się

do powstawania coraz to większych problemów zdrowotnych u doświadczających ich jednostek (Atroszko i in., 2020). W niniejszej pracy ograniczyłem się do badania postrzeganego stresu, który jest definiowany jako „uczucia lub myśli, które dana osoba ma na temat tego, jak bardzo jest zestresowana w danym momencie lub w danym okresie czasu" (Phillips, 2013, s. 1453).

Dodatkową konsekwencją stresu wynikającego z uzależnienia od pracy jest wypalenie zawodowe (Clark i in., 2016; Maslach i Leiter, 2016). Wypalenie zawodowe jest definiowane jako syndrom będący efektem przewlekłego stresu w miejscu pracy, który nie został skutecznie opanowany. W swojej pracy wykorzystałem konceptualizację zgodną z najnowsza wersją Międzynarodowej Statystycznej Klasyfikacji Chorób i Problemów Zdrowotnych ICD-11 (Światowa Organizacja Zdrowia, 2019), w której wypalenie zawodowe charakteryzuje się trzema wymiarami: (1) wyczerpaniem, (2) cynizmem i (3) poczuciem niskiej skuteczności zawodowej. Wyczerpanie (1) odnosi się do uczucia wyczerpania lub braku energii. Cynizm (2) określa zwiększony dystans psychiczny do wykonywanej pracy, lub poczucie negatywizmu w stosunku do wykonywanej pracy. Poczucie niskiej skuteczności zawodowej (3) to do poczucie bycia nieefektywnym pracownikiem oraz poczucie braku spełnienia zawodowego.

2.1.2 Uzależnienie od nauki oraz zaangażowanie w naukę

Uzależnienie od nauki oraz zaangażowanie w naukę są konceptualizowane jako wczesne formy uzależnienia od pracy i zaangażowania w pracę (Atroszko i in., 2015; Schaufeli i Bakker, 2004). Oba zjawiska są definiowane analogicznie do zjawisk związanych z pracą i charakteryzują się tymi samymi siedmioma symptomami uzależnienia (istotność, tolerancja, modyfikacja nastroju, nawrót, symptomy odstawienne, konflikt oraz problemy) oraz trzema wymiarami zaangażowania (wigor, oddaniem się nauce oraz zaabsorbowanie). Badania

empiryczne wykazały, że uzależnienie od nauki i zaangażowanie w naukę mają podobne, ale nie identyczne, korelaty co uzależnienie od pracy i zaangażowanie w pracę (Atroszko, 2022a; Carmona-Halty i in., 2019; Schaufeli, 2017). W mojej rozprawie wykorzystałem powyższe konceptualizacje i analogiczne operacjonalizacje uzależnienie od nauki i zaangażowania w naukę, żeby móc zaobserwować różnice pomiędzy tymi zjawiskami, które nie wynikają z różnic w metodach pomiaru.

2.2 Sieciowe podejście do zjawisk psychologicznych

We współczesnej psychologii dominuje paradygmat, zgodnie z którym zjawiska psychologiczne są postrzegane jako cechy lub stany latentne. Według tego paradygmatu obserwowanie zjawisk psychologicznych w sposób bezpośredni jest niemożliwe (lub przynajmniej znacząco utrudnione), a wiedzę na ich temat czerpać można w sposób pośredni, przez obserwację ich obserwowalnych wskaźników, takich jak symptomy zaburzeń psychicznych (Bollen, 2002). Oznacza to, że zjawiska psychologiczne są czarnymi skrzynkami, których dokładny sposób działania jest nieznany, choć znane są ich skutki (Hoffart i Johnson, 2020).

Taki sposób rozumowania jest spójny z modelem medycznym, w którym za występowanie choroby odpowiada wspólna przyczyna (Borsboom, 2017). Nie przystaje on jednak do praktyki psychoterapeutycznej, z której wynika, że skutecznymi metodami terapii (powszechnymi w nurcie poznawczo-behawioralnym) są oddziaływania skupione na konkretnych zachowaniach i/lub myślach, a więc symptomach (Cuijpers, 2019). Tym samym wyniki badań dotyczące skuteczności psychoterapii sugerują, że symptomy mogą pełnić nie tylko rolę pasywnych wskaźników, ale również mieć bezpośredni udział w powstawaniu i utrzymywaniu się zaburzeń psychicznych. W konsekwencji zastosowanie innego

paradygmatu, niż ten powszechnie przyjęty, może być niezbędne do poznania dodatkowych właściwości symptomów (Borsboom, 2008, 2017; Borsboom i Cramer, 2013; Cramer i in., 2010; Van Der Maas i in., 2006).

2.2.1 Sieciowa teoria zaburzeń psychicznych

Propozycja nowego sposobu na skonceptualizowanie zaburzeń psychicznych została zawarta w sieciowej teorii zaburzeń psychicznych (Borsboom, 2017). Teoria ta zakłada, że żeby móc zaobserwować, co dzieje się w czarnych skrzynkach, jakimi są zaburzenia psychiczne, należy dokonać dwóch fundamentalnych zmian w sposobie myślenia o nich. Po pierwsze, należy zacząć traktować symptomy zaburzeń psychicznych jako „atomy psychologiczne", czyli części, z których można budować większą całość (tj. zaburzenia psychiczne). Po drugie, należy dopuścić, że pomiędzy tymi atomami mogą istnieć bezpośrednie związki (np. ciągłe skupianie się na pracy może prowadzić do konfliktów ze współmałżonkiem), które mogą przyczyniać się do powstawania i utrzymywania się zaburzeń psychicznych. Przyjęcie tych dwóch założeń pozwala skonceptualizować zaburzenie psychiczne jako sieć symptomów będących ze sobą w bezpośrednich związkach.

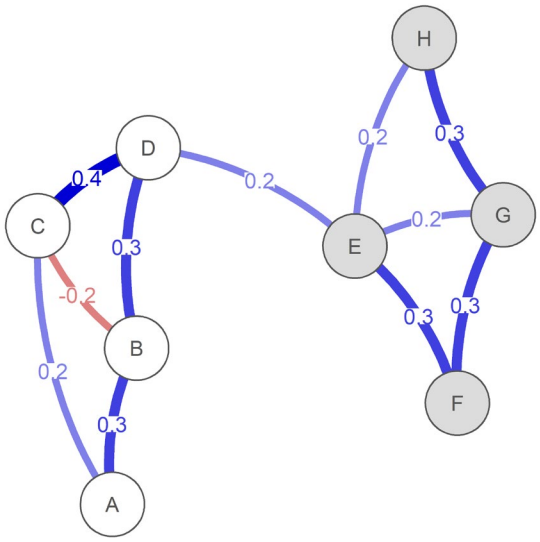
Sieć psychologiczna może zostać zobrazowana jako graf, którego wierzchołki odpowiadają poszczególnym symptomom, a krawędzie przedstawiają siłę bezpośrednich związków pomiędzy parami symptomów. Taki graf może być wzbogacony również o zjawiska znajdujące się w polu zewnętrznym zaburzenia, czyli elementy oddziałujące na symptomy zaburzenia, które same w sobie nie są jego symptomami. Przykładami takich elementów są symptomy innych zaburzeń psychicznych, inne zjawiska psychologiczne (lub ich wymiary), oraz doświadczenia życiowe/sytuacyjne (np. utrata pracy lub wysokie wymagania przełożonego). Oznacza to, że w węższym znaczeniu sieć psychologiczna zawiera tylko

symptomy zaburzenia, a w szerszym znaczeniu również zjawiska znajdujące się w jego polu zewnętrznym.

Na rysunku 1 przedstawiona została przykładowa sieć psychologiczna w szerszym znaczeniu, która zawiera dwa zaburzenia psychiczne. Symptomy każdego z zaburzeń są reprezentowane przez wierzchołki innego koloru (białego lub szarego). Gdy bezpośredni związek pomiędzy parą symptomów jest pozytywny, to krawędź ma kolor niebieski, a gdy negatywny, to kolor jest czerwony. Na każdej z krawędzi znajduje się również liczbowa wartość parametru modelu sieciowego, która podlega interpretacji.

Rysunek 1

Graf prezentujący przykładowa sieć psychologiczną zawierającą w sobie dwa zaburzenia psychiczne



Adnotacja. Wierzchołki grafu przedstawiają symptomy. Krawędzie grafu przedstawiają bezpośrednie związki pomiędzy parami symptomów. Symptomy reprezentujące to samo *zaburzenie* są reprezentowane przez wierzchołki identycznego koloru.

2.2.2 Gaussowski model grafowy

W niniejszej rozprawie do oszacowania wszystkich sieci psychologicznych wykorzystałem Gaussowski model grafowy (Epskamp i in., 2018). Jest to najpopularniejszy model statystyczny wykorzystywany do oszacowywania sieci psychologicznych w badaniach

poprzecznych (Robinaugh i in., 2020). Jego popularność wynika z wysokiej uniwersalności. Model ten może być używany zarówno, gdy dane są ciągłe i mają rozkład normalny, jak i w przypadku, gdy mają charakter porządkowy, a ich rozkład jest skośny. Drugi przypadek jest szczególnie popularny w badaniach nad zaburzeniami psychicznymi (Epskamp i Fried, 2018; Isvoranu i Epskamp, 2023). Parametry modelu oszacowanego z wykorzystaniem Gaussowskiego modelu grafowego przedstawiają korelacje cząstkowe pomiędzy badanymi zmiennymi, które zostały poddane regularyzacji, co oznacza, że najmniejsze parametry, które i tak nie mogłyby zostać poddane substantywnej interpretacji (np. 0,01), zostały ograniczone do zera (Epskamp i Fried, 2018).

2.2.3 Interpretacja sieci psychologicznych

Celem interpretowania sieci psychologicznych jest identyfikacja procesów odpowiedzialnych za powstawanie i utrzymywanie się zaburzeń psychicznych. Procesy, jakie można zidentyfikować w sieciach psychologicznych, odnoszą się do roli pojedynczego związku pomiędzy symptomami (reprezentowanego w modelu sieciowym przez krawędź), do roli pojedynczego symptomu (reprezentowanego w modelu sieciowym przez węzeł) lub do roli grupy symptomów (reprezentowanych w modelu sieciowym przez grupę węzłów).

W przypadku pojedynczych związków pomiędzy symptomami poszukuje się w sieci dwóch rodzajów krawędzi. Po pierwsze, najsilniejszych krawędzi pomiędzy symptomami, ponieważ to one reprezentują związki w największym stopniu odpowiedzialne za cały proces zaburzenia (zob. np. krawędź pomiędzy symptomem C i symptomem D na rysunku 1). Po drugie, krawędzi łączących symptomy zaburzenia ze zjawiskami znajdującymi się w polu zewnętrznym, ponieważ, zgodnie z teorią, to interwencje skupione na odpowiadających im

związkach mogą umożliwić skuteczną prewencję zaburzeń i/lub ograniczyć ich negatywne skutki (zob. krawędź pomiędzy symptomem D i symptomem E na rysunku 1).

W przypadku pojedynczych symptomów poszukuje się w sieci tych z nich, które mają największą szansę oddziaływać na wiele pozostałych symptomów. W celu określenia tej szansy wykorzystuje się miary centralności. Miarą centralności zazwyczaj stosowaną w sieciach psychologicznych jest siła, która przedstawia sumę bezwzględnych wag wszystkich krawędzi połączonych z wierzchołkiem. Im wyższa siła, tym silniejsze i/lub liczniejsze związki ma dany symptom z pozostałymi symptomami. Oznacza to, że oddziaływania skierowane na niego mają większą szansę na skuteczną zmianę całego procesu związanego z zaburzeniem psychicznym.

W przypadku grup symptomów poszukuje się w sieci takich grup wierzchołków (nazywanych klastrami), które dzięki obecności wielu wzajemnych krawędzi pozostają w dużej współzależności. Obecność klastrów w sieci sugeruje, że oddziaływania na pojedyncze symptomy może być nieskuteczne, ponieważ mogą być kontrowane przez oddziaływania pozostałych symptomów. Tym samym symptomy będące częścią klastra oraz ich bezpośrednie związki stają się naturalnymi kandydatami na bardziej złożone oddziaływania na wiele symptomów i związków jednocześnie.

To, jak dużą szansę powodzenia mają interwencje skupione na konkretnych symptomach i związkach między nimi, zależy od tego, jak dobrze model sieciowy obrazuje faktyczny proces zaburzenia. W celu określenia tej szansy wykorzystuje się miarę nazywaną przewidywalnością, która określa, jak duży procent wariancji każdego symptomu może być wyjaśniony przez stan sąsiadujących symptomów (Haslbeck i Waldorp, 2018). Im wyższa przewidywalność symptomów, tym większa szansa, że na podstawie modelu sieciowego uda się stworzyć skuteczne oddziaływania terapeutyczne i prewencyjne. W przypadku danych

ciągłych przewidywalność odpowiada procentowi wyjaśnianej wariancji (R^2), a w przypadku danych porządkowych procentowi wyjaśnianej wariancji, z wariancji, która nie mogła zostać wyjaśniona z wykorzystaniem rozkładu brzegowego (rozkład brzegowy pozwala określić jaki procent wariancji symptomu można przewidzieć znając jedynie najczęściej udzielaną odpowiedź na pytanie testowe; Haslbeck i Waldorp, 2018).

3. Badania własne

3.1 Sieciowe podejście do uzależnienia od pracy oraz uzależnienia od nauki

Pomimo dobrze udokumentowanych związków uzależnienia od pracy z zaangażowaniem w pracę, wypaleniem zawodowym, stresem, oraz szeregiem innych zjawisk, etiologia uzależnienia od pracy wciąż nie jest w pełni poznana, a dokładne procesy odpowiedzialne za powstawanie i utrzymywanie się tego zaburzenia oraz jego współwystępowanie z innymi zjawiskami psychologicznymi pozostają głównie w obszarze rozważań teoretycznych (Atroszko i in., 2019; Atroszko i in., 2020; Clark i in., 2016; Cossin i in., 2021; Di Stefano i Gaudiino, 2019; Griffiths i in., 2018; Kun i in., 2021; Lee i in., 2022; Morkevičiūtė i in., 2021). Jednocześnie w badaniach empirycznych obserwowane są związki pomiędzy symptomami, które nie są spójne z konceptualizacją uzależnienia opartą o wspólną przyczynę, tj. cechę lub stan latentny (Atroszko i in., 2017; Bellali i in., 2023; Denizci Nazlıgül i in., 2022; Falco i in., 2022; Fekih-Romdhane i in., 2022; Molino i in., 2022). Sieciowa teoria zaburzeń psychicznych może umożliwić połączenie wiedzy pochodzącej z rozważań teoretycznych, wyników badań empirycznych oraz praktyki psychoterapeutycznej. Tym samym może pomóc odpowiedzieć na pytania, jak wygląda proces odpowiedzialny za uzależnienie, jaką rolę w tym procesie odgrywają wymiary zaangażowania w pracę oraz postrzegany stres, a także jak proces uzależnienia może przekładać się na wymiary wypalenia oraz postrzegany stres. Co więcej, skonceptualizowanie uzależnienia od pracy i uzależnienia od nauki jako dynamicznego systemu symptomów może pomóc wyjaśnić, z jakich fragmentów procesu uzależnienia wynikają różnice obserwowane pomiędzy tymi zjawiskami (Andreassen i in., 2018; Atroszko, 2022a). Poniżej zaprezentowałem, na które pytania badawcze poszukiwałem odpowiedzi w każdym z artykułów cyklu.

ARTYKUŁ 1. Jaka jest struktura procesu odpowiedzialnego za uzależnienie od pracy?

ARTYKUŁ 2. Jaką rolę w procesie odpowiedzialnym za uzależnienie od pracy odgrywają wymiary zaangażowania w pracę?

ARTYKUŁ 3. Jaką rolę w procesie odpowiedzialnym za uzależnienie od pracy odgrywa postrzegany stres? Jak proces uzależnienia od pracy przekłada się na wymiary wypalenia zawodowego oraz postrzegany stres?

ARTYKUŁ 4. Jaka jest struktura procesu odpowiedzialnego za uzależnienie od nauki? Jaką rolę w procesie odpowiedzialnym za uzależnienie od nauki odgrywają wymiary zaangażowania w naukę? Jak proces odpowiedzialny za uzależnienie od nauki różni się od procesu odpowiedzialnego za uzależnienie od pracy?

3.2 Wyniki przeprowadzonych badań

Przed omówieniem konkretnych wyników przeprowadzonych badań należy zaznaczyć, że w ramach niniejszego cyklu artykułów oszacowanych zostało 12 modeli sieciowych, z czego część stanowiły grafy posiadające te same wierzchołki, ale różniące się wartościami parametrów na krawędziach. Jest to konsekwencją tego, że w **ARTYKUŁACH 1**, **2** i **4** parametry modeli były szacowane w kilku zbiorach danych (zob. tabela 1). W rezultacie, oszacowanych zostało kilka grup modeli o identycznych wierzchołkach i bardzo podobnych wartościach parametrów (cztery modele w **ARTYKULE 1**, trzy modele w **ARTYKULE 2**, oraz dwa razy po dwa modele w **ARTYKULE 4**). Z tego powodu, aby ułatwić czytelnikowi odbiór wyników, a w szczególności ich wizualnych aspektów, w niniejszym podrozdziale dla każdej z tych grup przedstawię jeden model z uśrednionymi wagami krawędzi. Natomiast, w odpowiadających im publikacjach dostępne są modele sieciowe oszacowane w konkretnych zbiorach danych oraz opisane są różnice zaobserwowane pomiędzy modelami w poszczególnych zbiorach danych. Aby dodatkowo ułatwić odczytywanie wyników na poszczególnych rysunkach, w tabeli 2 wyjaśniam sposób kodowania nazw symptomów i

wymiarów, a także kolorów oznaczających przynależność wierzchołków grafu do konkretnych zjawisk psychologicznych.

Tabela 2

Wyjaśnienie kodowania symptomów oraz wymiarów w postaci czteroliterowego skrótu oraz ich przynależności do zjawisk psychologicznych w postaci kolorów

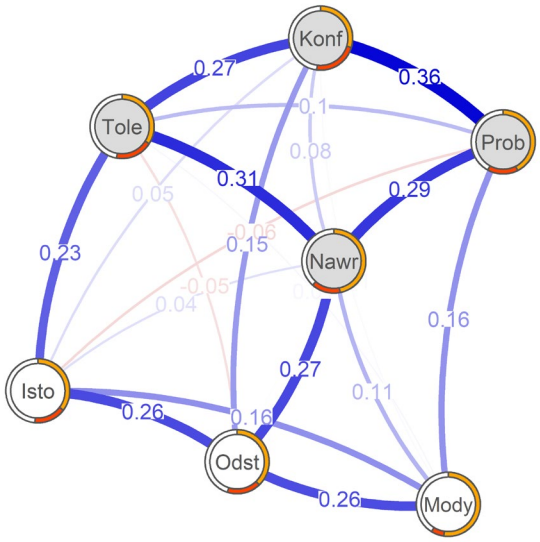
Zjawisko psychologiczne	Kolor wierzchołków	Symptom lub wymiar	Nazwa wierzchołka
Uzależnienie od pracy/nauki (mniej patologiczne symptomy)	Biały	Istotność	Isto
		Modyfikacja nastroju	Mody
		Symptomy odstawienne	Odst
Uzależnienie od pracy/nauki (bardziej patologiczne symptomy)	Szary	Tolerancja	Tole
		Nawrót	Nawr
		Konflikt	Konf
		Problemy	Prob
Zaangażowanie w pracę/naukę	Niebieski	Wigor	Wigo
		Oddanie się pracy/nauce	Odda
		Zaabsorbowanie	Zaab
Wypalenie zawodowe	Czerwony	Wyczerpanie	Wycz
		Cynizm	Cyni
		Poczucie skuteczności zawodowej	Skut
Postrzegany stres	Żółty	Postrzegany stres	Stre

Rysunek 2 przedstawia model będący efektem uśrednienia modeli sieciowych oszacowanych w **ARTYKULE 1**. W modelu znajdowały się jedynie symptomy uzależnienia od pracy, których średnia przewidywalność wynosiła 25,9%. Wśród symptomów uzależnienia od pracy zidentyfikowano dwa klastry symptomów przypominające podział na bardziej i mniej patologiczne symptomy uzależnienia od gier (Charlton i Danforth, 2007). Natomiast analiza wskaźnika centralności wskazała, że najbardziej centralnym węzłem w sieci uzależnienia od

pracy był nawrót (Nawr), podczas gdy najmniej centralnym węzłem była modyfikacja nastroju (Mody).

Rysunek 2

Uśredniona regularyzowana sieć korelacji cząstkowych dla uzależnienia od pracy (ARTYKUŁ 1)



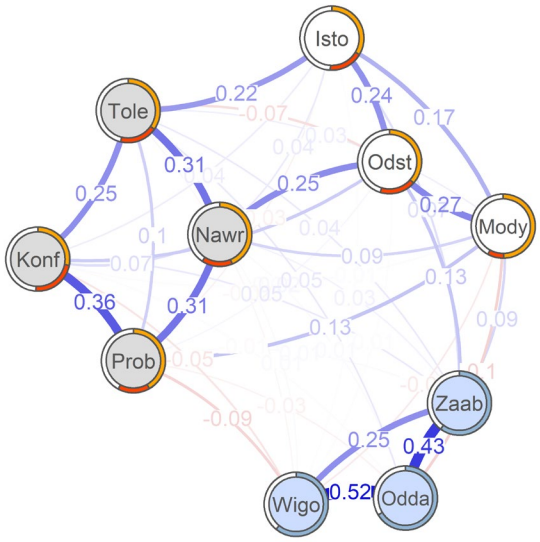
Adnotacja. Pierścienie wokół wierzchołków reprezentują przewidywalność (kolor pomarańczowy to przewidywalność wynikająca z rozkładu brzegowego; kolor czerwony to przewidywalność na podstawie pozostałych symptomów w sieci).

Rysunek 3 przedstawia model będący efektem uśrednienia modeli sieciowych oszacowanych w **ARTYKULE 2**, który zawiera symptomy uzależnienia od pracy i wymiary zaangażowania w pracę. Uwzględnienie w modelu wymiarów zaangażowania w pracę podniosło średnią przewidywalność symptomów uzależnienia od pracy do 26,8% oraz pozwoliło zidentyfikować trzeci klaster w sieci, składający się z wymiarów zaangażowania. Wiele z krawędzi łączących symptomy uzależnienia od pracy z wymiarami zaangażowania w pracę było relatywnie słabych. Wśród najważniejszych krawędzi, łączących oba zjawiska, należy wymienić negatywne krawędzie łączące wigor (Wigo) z modyfikacją nastroju (Mody), konfliktem (Konf) i problemami (Prob), negatywne krawędzie łączące oddanie się pracy (Odda) z modyfikacją nastroju (Mody), a także krawędzie łączące zaabsorbowanie (Zaab) z wszystkimi symptomami uzależnienia. Odpowiednio zmodyfikowana analiza centralności

wykazała, że kluczowymi węzłami łączącymi uzależnienie od pracy z zaangażowaniem w pracę były zaabsorbowanie (Zaab) oraz modyfikacja nastroju (Mody).

Rysunek 3

Uśredniona regularyzowana sieć korelacji cząstkowych dla uzależnienia od pracy oraz zaangażowania w pracę (ARTYKUŁ 2)



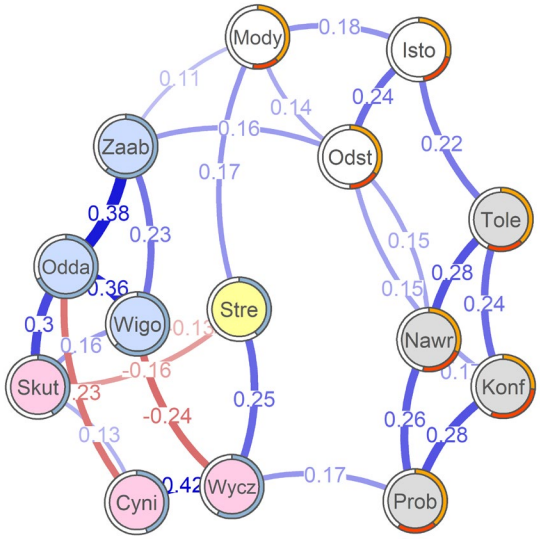
Adnotacja. Pierścienie wokół wierzchołków reprezentują przewidywalność (kolor pomarańczowy to przewidywalność wynikająca z rozkładu brzegowego, kolor czerwony to przewidywalność na podstawie pozostałych symptomów w sieci, kolor niebieski to procent wyjaśnianej wariancji [R^2]). Kodowanie wierzchołków wyjaśnione zostało w tabeli 2.

Rysunek 4 przedstawia model sieciowy oszacowany w **ARTYKULE 3**, który zawiera symptomy uzależnienia od pracy, wymiary zaangażowania w pracę, wymiary wypalenia zawodowego oraz postrzegany stres. Uwzględnienie w modelu wymiarów wypalenia zawodowego oraz postrzeganego stresu podniosło średnią przewidywalność symptomów uzależnienia od pracy do 29,6%, a także pozwoliło zidentyfikować czwarty klaster w sieci składający się z dwóch wymiarów wypalenia zawodowego (wyczerpania [Wycz] i cynizmu [Cyni]) i postrzeganego stresu (Stre). Dodatkowo, w tym modelu udało się zaobserwować, że poczucie skuteczności zawodowej (Skut) dołączyło do klastra zawierającego zaangażowanie w pracę. Uwzględnienie w modelu wszystkich czterech zjawisk psychologicznych pozwoliło ograniczyć liczbę krawędzi pomiędzy symptomami uzależnienia od pracy i zjawiskami

znajdującymi się w jego polu zewnętrznym do czterech. Były to związki pomiędzy (1) modyfikacją nastroju (Mody) i zaabsorbowaniem (Zaab), (2) modyfikacją nastroju (Mody) i stresem (Stre), (3) symptomami odstawiennymi (Odst) i stresem (Stre) oraz (4) problemami (Prob) i wyczerpaniem (Wycz).

Rysunek 4

Regularyzowana sieć korelacji cząstkowych dla uzależnienia od pracy, zaangażowania w pracę, wypalenia zawodowego oraz postrzeganego stresu (ARTYKUŁ 3)



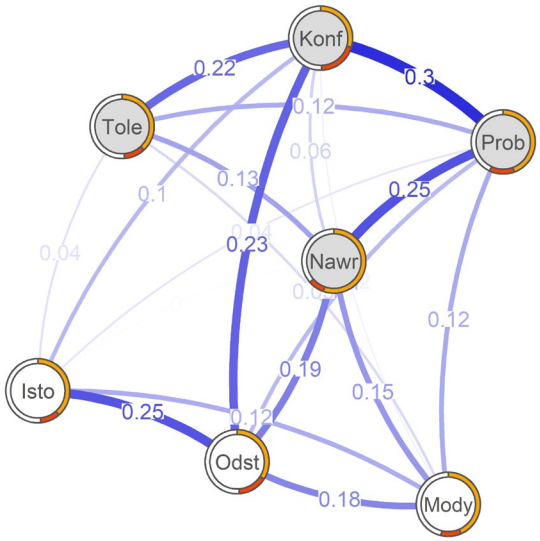
Adnotacja. Pierścienie wokół wierzchołków reprezentują przewidywalność (kolor pomarańczowy to przewidywalność wynikająca z rozkładu brzegowego, kolor czerwony to przewidywalność na podstawie pozostałych symptomów w sieci, kolor niebieski to procent wyjaśnianej wariancji [R^2]). Kodowanie wierzchołków wyjaśnione zostało w tabeli 2.

Rysunek 5 i rysunek 6 przedstawiają modele będące efektem uśrednienia dwóch grup modeli sieciowych oszacowanych w **ARTYKULE 4**. Modele te przedstawiają sieć zawierającą symptomy uzależnienia od nauki (rysunek 5) oraz sieć zawierającą symptomy uzależnienia od nauki wraz z wymiarami zaangażowania w naukę (rysunek 6). Średnia przewidywalność dla modelu zawierającego jedynie symptomy uzależnienia od nauki wynosiła 20,6%, a uwzględnienie w modelu wymiarów zaangażowania w naukę podniosło ją do 21,2%. Oba modele w znaczącym stopniu przypominają analogiczne modele uzyskane dla uzależnienia od pracy (zob. rysunek 2 oraz rysunek 3). Wśród najbardziej znaczących różnic dla modelu

zawierającego jedynie symptomy uzależnienia od nauki należy wskazać zdecydowanie słabsze krawędzie łączące tolerancję (Tole) z istotnością (Isto) i nawrotem (Nawr), a także mniejszą dysproporcję pomiędzy centralnością bardziej i mniej patologicznych symptomów uzależnienia. Natomiast w przypadku modelu zawierającego również zaangażowanie w naukę najbardziej znaczącą różnicę stanowiła wyższa niż w przypadku uzależnienia od pracy centralność konfliktu (Konf) i problemów (Prob), która łączyła się z ich większą rolą w łączeniu uzależnienia i zaangażowania.

Rysunek 5

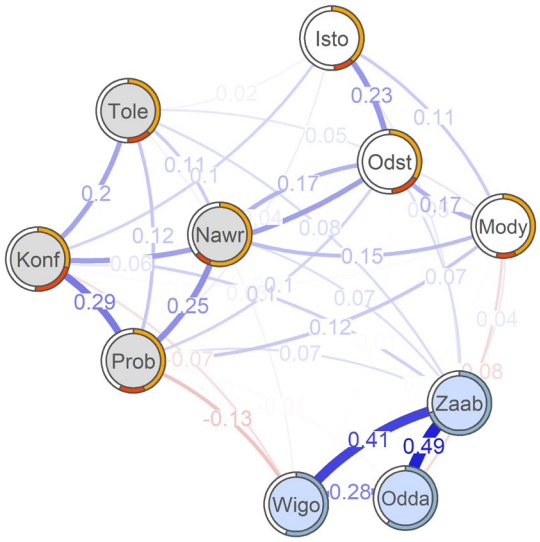
Uśredniona regularyzowana sieć korelacji cząstkowych dla uzależnienia od nauki (ARTYKUŁ 4)



Adnotacja. Pierścienie wokół wierzchołków reprezentują przewidywalność (kolor pomarańczowy to przewidywalność wynikająca z rozkładu brzegowego, kolor czerwony to przewidywalność na podstawie pozostałych symptomów w sieci, kolor niebieski to procent wyjaśnianej wariancji [R^2]). Kodowanie wierzchołków wyjaśnione zostało w tabeli 2.

Rysunek 6

Uśredniona regularyzowana sieć korelacji cząstkowych dla uzależnienia od nauki oraz zaangażowania w naukę (ARTYKUŁ 4)



Adnotacja. Pierścienie wokół wierzchołków reprezentują przewidywalność (kolor pomarańczowy to przewidywalność wynikająca z rozkładu brzegowego, kolor czerwony to przewidywalność na podstawie pozostałych symptomów w sieci, kolor niebieski to procent wyjaśnianej wariancji [R^2]). Kodowanie wierzchołków wyjaśnione zostało w tabeli 2.

3.3 Wnioski oraz implikacje praktyczne

W ramach niniejszej rozprawy doktorskiej uzależnienie od pracy oraz uzależnienie od nauki zostały skonceptualizowane jako dynamiczne systemy symptomów. W przypadku obydwu uzależnień zidentyfikowane zostały dwie grupy symptomów, które mogą wymagać zaplanowania niezależnych oddziaływań terapeutycznych. Pierwsza grupa przypominała peryferyjne (istotność, modyfikacja nastroju i symptomy odstawienne), a druga centralne (tolerancja, nawrót, konflikt i problemy) symptomy uzależnienia (Charlton i Danforth, 2007). Zarówno w przypadku uzależnienia od pracy, jak i uzależnienia od nauki, zaabsorbowanie zostało zidentyfikowane jako wymiar zaangażowania, który ma największą szansę przyczyniać się do rozwoju uzależnienia. Modele sieciowe oszacowane dla obydwu uzależnień były do siebie podobne, choć występowały pomiędzy nimi pewne różnice. Uzyskane wyniki zdają się wskazywać, że za oba uzależnienia może odpowiadać podobny mechanizm, który w ramach

oszacowanych modeli został uchwycony na innym etapie rozwoju człowieka. Jednocześnie, umiarkowany poziom przewidywalności symptomów obydwu zjawisk sugeruje, że zrozumienie procesów uzależnienia od pracy oraz uzależnienia od nauki może wymagać połączenia modelu sieciowego z modelem wspólnej przyczyny (w psychologii znanego jako model zmiennej latentnej; Bartholomew, 1987; Epskamp i in., 2017).

Dodatkowe uwzględnienie w polu zewnętrznym uzależnienia od pracy wypalenia zawodowego i postrzeganego stresu pozwoliło zaobserwować pełniejszy obraz potencjalnego procesu związanego z uzależnieniem. Zgodnie z teoriami uzależnienia od pracy, zaangażowania w pracę i wypalenia zawodowego, uzyskane wyniki sugerują, że zaangażowanie może prowadzić do uzależnienia, gdy jednostka zaczyna nawykowo wykorzystywać zaabsorbowanie w pracę do modyfikowania swojego nastroju, w okresach, w których odczuwa przewlekły stres (Atroszko, 2022a, 2022b; Atroszko i in., 2020; Bailey i in., 2017; Bianchi i Schonfeld, 2018; Maslach i Leiter, 2016). Co więcej, problemy z oderwaniem się od pracy, będące cechą charakterystyczną zaabsorbowania, mogą prowadzić do symptomów odstawiennych, gdy praca przestaje być możliwa. Jednocześnie wraz z postępowaniem uzależnienia od pracy pogłębiają się problemy zdrowotne wynikające z nadmiernego oddawania się pracy. Dyskomfort fizyczny przekłada się na mniej energii do oddawania się pracy, a więc na wyższe wyczerpanie. Przemęczenie może bezpośrednio wpływać na pozostałe komponenty wypalenia, które uniemożliwia pozytywne zaangażowanie w obowiązki zawodowe (Maricuțoiu i in., 2017). W ten sposób powstaje błędne koło, gdzie osoba pracuje motywowana tylko poczuciem kompulsji wynikającym z uzależnienia, tym samym pogłębiając swoje problemy zdrowotne i osobiste, co tylko zwiększa dalszą potrzebę ucieczki od doświadczanych negatywnych stanów.

Na podstawie uzyskanych wyników można zaproponować trzy oddziaływania terapeutyczne, które mogą pomóc zarówno osobom uzależnionym od pracy, jak i osobom będącym w grupie ryzyka tegoż uzależnienia (podobne oddziaływania mają również sporą szansę na skuteczność w przypadku uzależnienia od nauki). Po pierwsze, należy uczyć osoby pracujące rozróżniać pomiędzy zdrowym i niezdrowym rodzajem zaabsorbowania pracą, gdzie pierwsze trwa kilka godzin i przypomina pozytywny stan „flow" (Schaufeli i in., 2002), a drugie trwa wiele dni (lub tygodni) i prowadzi do zaniedbywania pozostałych obszarów życia. Szczególnie istotne wydaje się w tym wypadku podkreślenie, że pozytywne i negatywne zaabsorbowanie mogą występować równocześnie i to skupienie się na rozpoznawaniu negatywnych konsekwencji płynących z nadmiernego oddawania się pracy jest kluczowe w prawidłowym zidentyfikowaniu istnienia procesu uzależnienia. Zdobytą wiedzę można połączyć z nauką praktyki uważności (mindfulness), która promuje bycie obecnym „tu i teraz", nieruminowanie nad przeszłością, oraz większą świadomość doznań płynących z własnego ciała i psychiki, co może pomagać jednostkom odrywać się od pracy w odpowiednim momencie i ograniczać negatywne doświadczenia z tym związane (tj. symptomy odstawienne; Creswell, 2017). Po drugie, młodzież i pracujących dorosłych należy uczyć rozróżnienia pomiędzy adaptacyjnymi i nieadaptacyjnymi schematami radzenia sobie ze stresem. W ramach przykładów można wskazywać, że zamiast radzić sobie ze stresem poprzez ucieczkę w pracę, osoba może skupiać się na rozwiązywaniu problemu będącego źródłem stresu, szukać wsparcia rodziny i bliskich, praktykować uważność lub zasięgnąć pomocy w ramach sformalizowanej psychoterapii skupionej na pracy nad kompetencjami społecznymi oraz nawykami prozdrowotnymi związanymi z dietą, snem i aktywnością fizyczną, a także skupionej na czynnikach ryzyka predysponujących do uzależnienia (wśród których znajdują się m.in. perfekcjonizm, lęk, depresja i potrzeba kontroli; Andreassen i in., 2016; Clark i in., 2016). Po

trzecie, należy uświadamiać osoby pracujące, że mogą one wykonywać swoje zadania na najwyższym poziomie jedynie przez określoną liczbę godzin w trakcie każdego dnia. Równolegle, należy je edukować, że jeżeli nie zmniejszą one intensywności swojej pracy, to mogą doświadczyć niższej skuteczności w pracy, wypalenia zawodowego, gorszego zdrowia fizycznego i psychicznego, a także przedwczesnej śmierci (Bannai i Tamakoshi, 2014; Clark i in., 2016; Pega i in., 2021).

Ze względu na dużą wagę tematu, powyższe oddziaływania terapeutyczne powinny zostać wdrożone do programu edukacji szkolnej, szkoleń przeprowadzanych w organizacjach, a także w ramach kampanii społecznych organizowanych przez Ministerstwo Zdrowia oraz Ministerstwo Rodziny, Pracy i Polityki Społecznej. Przepracowanie jest problemem ważnym społecznie, ze względu na koszty, które generuje zarówno przez spadek wydajności osób pracujących, jak i wydatki na pokrycie świadczeń zdrowotnych koniecznych do wdrożenia w przypadku pogarszającego się stanu zdrowia spowodowanego kompulsywną pracą jednostek. Do tego należy dodać jeszcze niemierzalne, indywidualne straty, które osoba uzależniona ponosi każdego dnia, związane między innymi z dyskomfortem, niższą jakością życia i konfliktami z najbliższymi.

3.4 Mocne strony, ograniczenia oraz kierunki przyszłych badań

Według mojej wiedzy, badania wchodzące w skład niniejszej rozprawy doktorskiej stanowią pierwszą kompleksową próbę zbadania uzależnienia od pracy oraz uzależnienia od nauki w paradygmacie opartym o sieciową teorię zaburzeń psychicznych (Borsboom, 2017). W ramach przeprowadzonych badań skupiłem się nie tylko na bezpośrednich związkach pomiędzy symptomami uzależnień, ale również na ich bezpośrednich związkach z innymi zjawiskami psychologicznymi, co w empirycznej literaturze dotyczącej sieciowego podejścia

do zjawisk psychologicznych zdarza się stosunkowo rzadko (Fried, 2020). Ponadto stosując metodę polegającą na łącznym oszacowaniu modeli na podstawie danych z kilku prób, uzyskałem wyższą moc statystyczną oraz zmaksymalizowałem szansę na dokładne oszacowanie najważniejszych parametrów w modelach. Natomiast stosując ilościowe metody porównywania parametrów, ograniczyłem element subiektywizmu w ocenie podobieństw i różnic pomiędzy oszacowanymi modelami. W konsekwencji zwiększając szansę na replikowalność i generalizowalność uzyskanych wyników. Jednocześnie wykorzystując analogiczne narzędzia do pomiaru zjawisk związanych z pracą i nauką, byłem w stanie zaobserwować różnice pomiędzy procesami uzależnienia od pracy i uzależnienia od nauki, które nie wynikają z różnic w metodach pomiaru.

Niniejsza rozprawa doktorska nie jest jednak wolna od ograniczeń, a najważniejsze z nich wiążą się z ograniczeniami Gaussowskiego modelu grafowego, który jest modelem eksploracyjnym opartym na korelacjach cząstkowych. Konsekwencją eksploracyjnego charakteru Gaussowskiego modelu grafowego jest brak możliwości narzucenia na model ograniczeń wynikających z teorii badanych zjawisk. W efekcie oszacowane parametry modelu zależą jedynie od danych i mogą nieadekwatnie reprezentować model populacyjny. W niniejszej rozprawie doktorskiej starałem się zaadresować ten problem poprzez oszacowywanie Gaussowskich modeli grafowych w kilku próbach jednocześnie, co miało na celu zwalidowanie zaobserwowanych parametrów. W związku z byciem opartym o korelacje cząstkowe Gaussowski model grafowy nie umożliwia testowania hipotez na temat kierunkowości zaobserwowanych związków, co w połączeniu z poprzecznym charakterem analizowanych danych znacząco ogranicza możliwości wnioskowanie przyczynowo-skutkowego na podstawie uzyskanych wyników. Co prawda wyniki wcześniejszych badań empirycznych sugerują, że z modeli sieciowych oszacowanych z wykorzystaniem danych

poprzecznych można wyciągać pewnego rodzaju wnioski dotyczące przyczynowych zależności (Elliott i in., 2020; Rodebaugh i in., 2018; Tejada-Gallardo i in., 2022), to analizy teoretyczne wskazują, że powinny być to wnioski bardzo ostrożne (Bos i in., 2017; Bringmann i in., 2019). Z powyższych powodów w artykułach wchodzących w skład mojej rozprawy doktorskiej starałem się możliwie często odnosić się do teorii analizowanych zjawisk oraz ich bezpośrednich definicji, aby uniknąć wyciągania zbyt daleko idących wniosków co do przyczynowości pomiędzy elementami modeli. Z tych też powodów, przyszłe badania powinny skupić się na potwierdzeniu uzyskanych wyników w badaniach podłużnych. Jednocześnie biorąc pod uwagę ograniczenia Gaussowskiego modelu grafowego naturalnym kierunkiem przyszłych badań wydaje się również walidacja uzyskanych wyników z wykorzystaniem modeli równań strukturalnych, które mogą w sposób konfirmacyjny zestawić wyniki badań sieciowych z modelem teoretycznym stojącym za procesami uzależnienia od pracy i uzależnienia od nauki oraz narzucić oczekiwany kierunek związków pomiędzy elementami modelu.

Kolejnym ograniczeniem niniejszej rozprawy doktorskiej jest jednopozycyjny pomiar symptomów uzależnienia od pracy oraz nauki. Jednopozycyjne miary charakteryzują się niższą rzetelnością niż miary wielopozycyjne, co może wpływać na wartości parametrów oszacowanych modeli. Co więcej, uzyskane wyniki mogą być silnie zależne od treści pozycji testowych użytych do pomiaru konkretnych symptomów. W rezultacie przyszłe badania powinny skupić się na oszacowaniu sieci uzależnienia od pracy oraz uzależnienia od nauki z wykorzystaniem innych miar tych zjawisk, w których poszczególne symptomy są mierzone wieloma pozycjami testowymi, tak jak miało to miejsce w niniejszej rozprawie w przypadku zaangażowania, wypalenia oraz stresu.

Wśród innych ograniczeń mojej rozprawy doktorskiej należy wymienić również ograniczone pole zewnętrzne, w którym nie znalazły się żadne czynniki pozapsychologiczne (np. sytuacja materialna), a jedynym czynnikiem psychologicznym niebędącym unikalnym dla pracy i nauki był stres. Ponadto niniejsza rozprawa doktorska charakteryzuje się ograniczoną możliwość uogólniania wyników, która wynika z przeprowadzenia badań w populacjach nieklinicznych w jedynie dwóch europejskich krajach. W przyszłych badaniach oba z tych ograniczeń mogą zostać przezwyciężone przez rozszerzanie pola zewnętrznego sieci uzależnienia od pracy oraz uzależnienia od nauki o nowe zjawiska, a także przez prowadzenie badań w populacjach pochodzących z różnych krajów oraz reprezentujących różne nasilenie uzależnień, w tym populacjach klinicznych.

Należy jednocześnie zaznaczyć, że przyszłe badania nie powinny ograniczać się jedynie do przezwyciężania ograniczeń badań zaprezentowanych w ramach niniejszej rozprawy doktorskiej. Istnieje co najmniej kilka kierunków dalszej eksploracji użyteczności sieciowej teorii zaburzeń psychicznych w obszarze uzależnienia od pracy i uzależnienia od nauki. Po pierwsze, przyszłe badania mogą skupiać się na sprawdzaniu, czy na podstawie modeli sieciowych możliwe jest stworzenie skutecznych interwencji terapeutycznych (lub prewencyjnych). Po drugie, sieciowe podejście do uzależnienia od pracy oraz uzależnienia od nauki może zostać wykorzystane do badania różnic w procesach odpowiedzialnych za te zjawiska w populacjach w różnym wieku, będących różnej płci, wykonujących różnego rodzaju zawody (lub w przypadku uczniów uczęszczających do klas o różnych profilach), i/lub pracujące/uczące się zgodnie z innym harmonogramem. Przyszłe badania mogą również wykorzystywać metodę dzienniczkową lub metodę pobierania próbek doświadczenia, żeby sprawdzać jakie oddziaływania pomiędzy symptomami uzależnienia od pracy oraz uzależnienia od nauki występują w bardzo krótkich odstępach czasowych. Wreszcie,

niezależnie od użytych metod analitycznych, bazując na wynikach niniejszej rozprawy doktorskiej, przyszłe badania powinny skupiać się na poszukiwaniu dalszych podobieństw i różnic pomiędzy uzależnieniem od pracy i uzależnieniem od nauki. Z jednej strony dobrym czasem na ich identyfikacje może być moment, w którym jednostka kończy edukację i rozpoczyna pracę zawodową. Z drugiej strony dobrym sposobem na ich identyfikacje może być porównanie możliwie jednorodnych grup osób uczących się i osób pracujących (np. licealistów z osobami pracującymi w wieku średnim).

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5. Załączniki

5.1 Załącznik A – Oświadczenia współautorów publikacji

Publication #1: Bereznowski, P., Atroszko, P. A., Konarski, R. (2024). Network approach to work addiction: A cross-cultural study. *SAGE Open*. https://doi.org/10.1177/21582440241245414

Name of the candidate: Piotr Bereznowski

The candidate's percentage contribution to the publication: 60%

Statement indicating the candidate's contribution to the publication: The candidate assisted with obtaining funding, literature search, study design and concept, statistical analyses, data interpretation, generation of the initial draft of the manuscript, manuscript preparation and editing, and final editing and approval of the manuscript.

The contribution of the co-authors: The co-authors assisted with literature search, study design and concept, data collection, data interpretation, generation of the initial draft of the manuscript, manuscript preparation and editing, and final editing and approval of the manuscript.

We, the undersigned, co-authors of the above publication, confirm that the above publication has not been submitted as evidence for which a degree or other qualification has already been awarded.

We, the undersigned, further indicate the candidate's contribution to the publication in our joint statement below.

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Publication #2: Bereznowski, P., Bereznowska, A., Atroszko, P. A., Konarski, R. (2023). Work addiction and work engagement: A network approach to cross-cultural data. *International Journal of Mental Health and Addiction*, *21*, 2052–2076. https://doi.org/10.1007/s11469-021-00707-8

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The contribution of the co-authors: The co-authors assisted with literature search, design and concept, data interpretation, generation of the initial draft of the manuscript, manuscript preparation and editing, and final editing.

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Publication #3: Bereznowski, P., Atroszko, P. A., Konarski, R. (2023). Work addiction, work engagement, job burnout, and perceived stress: A network analysis. *Frontiers in Psychology, 14*, artykuł 1130069. https://doi.org/10.3389/fpsyg.2023.1130069

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I, the undersigned, co-authors of the above publication, confirm that the above publication has not been submitted as evidence for which a degree or other qualification has already been awarded.

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5.2 Załącznik B - ARTYKUŁ 1

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Network Approach to Work Addiction: A Cross-Cultural Study

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Abstract

We aimed to estimate and compare networks of work addiction among Norwegian and Polish working individuals. The Bergen Work Addiction Scale was used to measure work addiction in four samples, two comprising responses of working Norwegians ($n_1 = 16{,}426$; $n_2 = 764$) and two comprising responses of working Poles ($n_3 = 719$; $n_4 = 711$). The networks were estimated jointly with the fused graphic lasso method. Additionally, we estimated symptoms' centrality, symptoms' predictability, and networks' stability, as well as quantitatively compared the four networks. The results showed highly similar networks across the four samples. There were several strong direct relationships between symptoms. The most and the least central symptoms were Relapse and Mood modification, respectively. Mean symptom predictability varied between 22.6 and 28.3% across samples. We discussed the possible intervention strategies based on the obtained results.

Plain Language Summary

Purpose: The aim of this study was to investigate direct relationships between symptoms of work addiction. Methods: We used a novel analytical approach (i.e., network analysis) and applied it to previously gathered responses of working individuals from Norway and Poland to investigate relationships between symptoms of work addiction. Conclusions: We found two groups of symptoms of work addiction. The first group included salience, mood modification and withdrawal. The second group included tolerance, relapse, conflict, and problems. It seems that the first group includes symptoms which could be considered as less pathological or early signs of work addiction, while the second group includes more pathological symptoms responsible for the strongest deterioration of well-being of individuals addicted to work. The two groups were connected through relationships between relapse and withdrawal, and between salience and tolerance. Implications: The identified groups of symptoms as well as the connections between those groups might be used to design new prevention programs and therapeutic interventions. Limitations: The study had cross-sectional design, which means that individuals' responses were collected at a single point in time. Consequently, causal inference based on the results of this study is limited.

Keywords

network analysis, network approach, the Bergen Work Addiction Scale, work addiction, workaholism

Introduction

Work addiction (often called workaholism) is a worldwide mental health problem with estimates of a prevalence rate of up to 10% (Atroszko et al., 2020). Work addiction deteriorates the private, occupational, and family life of those addicted to work and people around them (Clark et al., 2016; Griffiths et al., 2018; Patel, 2011). Moreover, work addiction is related to long working hours and stress which in turn leads to cardiovascular disease (Pega et al., 2021), cancer (Cohen et al., 2007), diabetes (Kivimäki et al., 2015), substance use and abuse (Virtanen et al., 2015), as well as depression and anxiety (Bannai & Tamakoshi, 2014). Taking that into consideration, grasping the processes of development and

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maintenance of work addiction is an important goal in mental health research.

Understanding the processes behind work addiction is necessary to develop effective prevention and intervention programs. Unfortunately, despite a growing number of research on this subject, work addiction is still considered a syndrome, a set of symptoms correlated with each other, whose etiology is not fully understood (Atroszko et al., 2019; Clark et al., 2016; Cossin et al., 2021; Kun et al., 2021; Morkevičiūtė et al., 2021). This gap in knowledge of its underpinnings may be related to the theoretical framework used to study work addiction. So far, work addiction has been investigated in the latent variable framework in which symptoms of work addiction are assumed to be effects of a common cause. In this framework, a common cause resembles a black box in which modes of operation are secret, but its consequences are visible as symptoms (Hoffart & Johnson, 2020). Consequently, a different theoretical model might be needed to discover the processes responsible for the development and maintenance of work addiction. Recently, Borsboom (2017) postulated the network theory of mental disorders in which the development and maintenance of mental disorders are explained by direct relationships between their symptoms. Thus changing the role of symptoms of mental disorders from passive indicators of latent variables to pivotal elements of the processes responsible for the existence of mental disorders. During the past decade, the network theory of mental disorders has become a popular framework for studying mental disorders (Contreras et al., 2019; Robinaugh et al., 2020), and produced a few promising hypotheses for the etiology and maintenance of mental disorders (for examples, see Elliott et al., 2020; Rodebaugh et al., 2018; Tejada-Gallardo et al., 2022). Therefore, a conceptualization of work addiction within the network theory framework might allow moving forward the research on its etiology and regulatory mechanisms.

To investigate work addiction within the network theory framework, we estimated four undirected partial correlation networks based on data from Norway and Poland. The estimated networks allowed us to identify processes, which may be responsible for the development and maintenance of work addiction. We identified the processes by investigating (a) pairwise relationships between symptoms of work addiction, (b) groups of tightly connected symptoms that may synchronize their states easily (i.e., clusters of symptoms), (c) the strength of potential influence of a symptom on other symptoms, and (d) probability that a state of a symptom may be influenced by other symptoms. Moreover, we compared the networks of work addiction among Norwegians and Poles of diverse sociodemographic backgrounds to evaluate how replicable the results are.

The remainder of this section is structured as follows. First, we provide the background for this study by describing (a) the definition and symptoms of work addiction (as network analysis is tightly connected with the operationalization and measurement of symptoms), (b) the assumptions of the network theory of mental disorders, and (c) the cultural and sociodemographic differences which could lead to differences in the estimated networks. Second, we review the existing literature on (a) work addiction in the latent variable framework, (b) work addiction in the network theory framework, and (c) the replicability of psychological networks in general (to evaluate how likely we are to observe similar networks). Finally, we synthesize previous research and form hypotheses for the present study.

Background

Definition and Symptoms of Work Addiction

Work addiction has been defined as "a compulsion to work and preoccupation with work activities leading to a significant harm and distress of a functionally impairing nature to the individual and/or other significantly relevant relationships (friends and family). The behavior is characterized by the loss of control over the working activity and persists over a significant period of time. This problematic work-related behavior can have varying intensity from mild to severe" (Atroszko et al., 2019, p. 9).

In the addiction framework, work addiction is measured with the Bergen Work Addiction Scale (BWAS; Andreassen et al., 2012), which is an instrument developed based on a common addiction components model (Brown, 1993; Griffiths, 2005). The model includes seven addiction symptoms: (1) *salience* ("the activity dominates thinking and behavior"; Andreassen et al., 2012, p. 266), (2) *tolerance* ("increasing amounts of the activity are required to achieve initial effects"; Andreassen et al., 2012, p. 266), (3) *mood modification* ("the activity modifies/improves mood"; Andreassen et al., 2012, p. 266), (4) *relapse* ("tendency for reversion to earlier patterns of the activity after abstinence or control"; Andreassen et al., 2012, p. 266), (5) *withdrawal* ("occurrence of unpleasant feelings when the activity is discontinued or suddenly reduced"; Andreassen et al., 2012, p. 266), (6) *conflict* ("the activity causes conflicts in social relationships and other activities"; Andreassen et al., 2012, p. 266), and (7) *problems* (negative outcomes of excessive working; Andreassen et al., 2012; Griffiths, 2011).

The Network Theory of Mental Disorders

The network theory of mental disorders has been developed by Borsboom (2017). The theory's core assumption

is that it is impossible to isolate one central disease mechanism in mental disorders. Instead, the author believes that causal interactions between symptoms generate feedback loops, and the activation of certain constellations of symptoms manifests itself as what is phenomenologically recognized as a mental disorder.

The symptoms in this theory are represented by *nodes*, and the direct relationships between pairs of symptoms are represented by *edges*. A network is a graph of nodes connected by the edges. The nodes can be connected to one another directly or indirectly via intermediary symptoms. The theory assumes that the single symptoms can be activated by the external field (factors outside the network, e.g., adverse life events may trigger salience), but also that one symptom can activate the other (e.g., salience may activate tolerance). The network is highly synchronized if all the symptoms interact with one another with similar strength. However, the symptoms can also form clusters, which are groups of symptoms within the network that have stronger relationships with one another. In that case, the symptoms within the cluster highly influence themselves and thus may remain active while other symptoms in the network are not. Tightly related symptoms can cause self-sustainable loops that are difficult to break and cause a considerable challenge in therapy.

Analyzing a network is a multistep process that aims to find patterns of edges (Epskamp et al., 2018). Firstly, it is necessary to examine which edges connect nodes, whether they are positive or negative, their strength, and search for clusters of nodes in the network. The next stage includes investigating the stability of estimated networks, indicating if a third stage, network inference, is warranted. The following step is an investigation of node centrality, meaning how strongly a node could influence and/or be influenced by other nodes in the network (Epskamp et al., 2018), and node predictability, which examines to what extent a node can be predicted by all the other nodes in the network (Haslbeck & Waldorp, 2018). The last step can only be performed when several networks are estimated since it explores the differences between them.

The major asset of this theory is its high suitability for clinical practice. It may be applied in both diagnosis and therapy. Recognizing which symptoms are present and what interactions within the network sustain them is vital for comprehensive diagnosis. Consequently, effective treatment of the disorder should involve modifying or reducing connections between the symptoms. This assumption seems congruent with a clinical practice in which intervention strategies focused on particular symptoms and relations between them, for example in cognitive-behavioral therapy, are usually successful in work addiction treatment (Andreassen, 2014; Atroszko, 2022; Cossin et al., 2021; Robinson, 2014). Therefore, the network approach to work addiction could constitute a bridge between the results of quantitative studies of work addiction and intervention strategies applied in clinical practice.

Borsboom (2017) in his work points to three types of interventions that are based on network theory. First is *symptom intervention* that aims to change the symptom directly. For example, a person experiencing anxiety after reducing the amount of time and effort devoted to work may take medication to ease withdrawal. The second are *interventions to the external field*, which stem from the assumption that in some cases the network will not self-sustain if the external trigger is removed. The author describes such networks as resilient, meaning that the dynamics between the symptoms are not strong enough to create feedback loops; therefore, they fade after the external factor is gone. For example, a person may be involved in excessive work in one organization and not in another organization, as the organizations differ in terms of organizational culture; thus, a change of organizational culture is a successful intervention. The third case is *network interventions* directed at changing the relationships between symptoms and reducing the feedback loops. This can be done, for example, by therapy, where a patient suffering from work addiction can learn how to deal with unpleasant feelings and tension which are typically modified through excessive work.

Cultural and Sociodemographic Differences

In this study, we aimed to investigate whether work addiction networks will replicate across samples of working individuals from different countries (Norway and Poland) and of diverse sociodemographic backgrounds (recent university graduates and individuals from the general working population). The most important work-related differences between Norway and Poland include, but are not limited to, gross domestic product (GDP) per capita, labor laws, social care regulations, and cultural differences (Poles score higher on power distance, masculinity, and uncertainty avoidance, Norwegians score higher on indulgence, and both nations score similarly in terms of individualism and long-term orientation; Hofstede et al., 2010). Taken together, these factors are reflected in considerable differences in the socioeconomic uncertainty between Norway and Poland, and these were found to affect work-related compulsive behaviors in previous studies in the two countries (Atroszko & Atroszko, 2021; Atroszko et al., 2017; Atroszko & Pallesen, 2014). The socioeconomic status of recent university graduates and individuals from the general working population differ due to age (recent graduates are younger), stage of career (recent graduates are at an early stage of career), education (not all working individuals are university graduates), job position (recent graduates are less likely

to have managerial positions), and salary and wealth (recent graduates have lower salaries and are less likely to accumulate wealth). These differences also co-occur with work motivation, which substantially changes during a lifetime (Kooij et al., 2010), and thus may influence the tendency to compulsive overworking. Nevertheless, Hu et al. (2014) showed that while European countries differ in terms of work addiction levels, they are rather homogeneous when compared to Asian countries (as they are more similar to each other than to Asian countries and differ less than Asian countries). Therefore, it is possible that the differences between Norwegian and Polish networks may not be as pronounced despite all the differences between the two countries.

Literature Review

The BWAS has been developed as a measure of a single latent factor of work addiction, which showed an acceptable fit to the data in the original study in Norway (RMSEA = 0.077; Andreassen et al., 2012) and a recent study in China (RMSEA = 0.063; Sun et al., 2023). However, other studies showed that there are some non-trivial relationships between the symptoms of work addiction, which could not be explained by a single latent variable of work addiction. While a few authors reported that they obtained RMSEAs above the acceptable threshold and stopped there (Bereznowski & Konarski, 2020; Lichtenstein et al., 2019; Orosz et al., 2016), others investigated which residual correlations between symptoms were needed to be allowed to obtain acceptable fit (see Table 1). The correlation between salience (1) and tolerance (2) was required in Poland (Atroszko et al., 2017), Greece (Bellali et al., 2023), and Italy (Falco et al., 2022). The correlation between salience (1) and mood modification (3) was required in Poland (Atroszko et al., 2017) and Greece (Bellali et al., 2023). The correlation between salience (1) and withdrawal (5) was required in Poland (Atroszko et al., 2017), Greece (Bellali et al., 2023), and Turkey (Denizci Nazlıgül et al., 2022). The correlation between salience (1) and problems (7) was required in Italy (Molino et al., 2022) and Turkey (Denizci Nazlıgül et al., 2022). The correlation between tolerance (2) and conflict (6) was required in Italy (Falco et al., 2022). The correlation between mood modification (3) and withdrawal (5) was required in Turkey (Denizci Nazlıgül et al., 2022). The correlation between conflict (6) and problems (7) was required in Turkey (Denizci Nazlıgül et al., 2022) and Lebanon (Fekih-Romdhane et al., 2022). In this paper, we hypothesize that these relationships may indicate the inadequacy of the latent variable framework to capture the direct relationships between symptoms postulated by the network theory of mental disorders (Borsboom, 2017).

To the best of our knowledge, there have been three studies investigating work addiction using the network theory framework. Two of them were direct extensions of this work (Bereznowski, Atroszko, & Konarski, 2023; Bereznowski, Bereznowska, et al., 2023) and, as such, do not constitute a valid source of hypotheses for the present study; thus, they will not be discussed here. The third study was conducted by Sun et al. (2023) and investigated the network of symptoms of work addiction and general anxiety in Chinese white-collar workers. Sun et al. (2023) showed that the five strongest edges in the estimated network were (a) Salience (1)—Tolerance (2), (b) Tolerance (2)—Problems (7), (c) Mood modification (3)–Withdrawal (5), (d) Salience (1)—Conflict (6), and (e) Mood modification (3)—Relapse (4), consecutively. Some of these connections resembled the correlations observed in previously discussed studies (i.e., a and c; see Table 1) and others did not (i.e., b, d, and e). Considering that Sun et al. (2023) reported an adequate fit of the single factor model to the data (RMSEA = 0.063) among the previously discussed research and did not investigate modification indices of the single factor model, it was unclear whether the differences are an indication that the structure of the work addiction network cannot be directly derived from the results of studies grounded in the latent variable

Table 1. Correlations Observed Between Residuals of the BWAS Items in Previous Research Grounded in the Latent Variable Framework.

Presence of correlation between symptoms number								
Authors	Country	1 and 2	1 and 3	1 and 5	1 and 7	2 and 6	3 and 5	6 and 7
Atroszko et al. (2017)	Poland	X	X	X				
Bellali et al. (2023)	Greece	X	X	X				
Denizci Nazlıgül et al. (2022)	Turkey			X	X		X	X
Falco et al. (2022)	Italy	X				X		
Fekih-Romdhane et al. (2022)	Lebanon							X
Molino et al. (2022)	Italy				X			

Note. 1 = Salience; 2 = Tolerance; 3 = Mood modification; 4 = Relapse; 5 = Withdrawal; 6 = Conflict; 7 = Problems.

framework or that the diverging results stem from cultural differences. Therefore, we decided to be cautious when formulating hypotheses.

When it comes to the replicability of estimated networks, previous research demonstrated that similarities of estimated networks depend on data and measurement instruments (Birkeland et al., 2020; Fried, 2017; Malgaroli et al., 2021). The networks are more likely to be similar when data is gathered in the same country (or culture) or among the same population (for example, the general population or clinical population). Moreover, similar demographics of the populations, such as similar age, the ratio of women to men, or educational background, also favor the estimation of similar networks. Estimating similar networks is also more likely to happen when the same set of symptoms is measured with identical wording of items, which indicates the use of the same instrument (Fried, 2017). Previous studies showed a satisfactory level of replicability of networks, especially when the same measurement tool was used in each sample (e.g., Bőthe et al., 2020; Fried et al., 2018; Hirota et al., 2020; Huang et al., 2020), even though the generalizability of such networks still has some limitations (Birkeland et al., 2020; Malgaroli et al., 2021). Therefore, the use of the same psychometric instrument in samples from populations of similar sociodemographic backgrounds decreases the chances of observing differences in estimated networks.

Present Study

Based on the addiction framework, it can be assumed that the process of increasing involvement in a behavior that is central in one's life (salience) is related to the development of compulsion because it gradually serves more and more mood modification purposes, which, in turn, increases tolerance, withdrawal, and relapse and leads to negative consequences in the form of conflicts and problems (Shaffer et al., 2004). Taking into account feedback loops, it can be expected that increasing problems may increase mood modification needs and aggravate tolerance, withdrawal, and relapse symptoms. These assumptions seem to find support in previous research (Atroszko et al., 2017; Bellali et al., 2023; Denizci Nazlıgül et al., 2022; Falco et al., 2022; Fekih-Romdhane et al., 2022; Molino et al., 2022; Sun et al., 2023). Therefore, we argue that work addiction could be conceptualized as a network of direct relationships between its symptoms. However, the support for each of the assumptions seems to be scattered across the literature. Out of the five strongest edges found by Sun et al. (2023), only two were found in the latent variable framework studies, and only one of these was found in more than a single study (i.e., the edge between salience and tolerance). While acknowledging the necessity for a confirmatory approach in behavioral sciences (Wagenmakers et al., 2012), we argue that, in the case of a complex network of interrelationships, imposing specific predictions in the context of vague and heterogeneous premises from previous studies as well as lack of solid theories may be impossible. Taking into account previous research, we expect to observe the edge between salience and tolerance to be among the strongest edges in the four estimated networks, but do not form any expectations with respect to other edges as we consider previous research inconclusive on that matter.

Considering similarities between European cultures in terms of work addiction intensity (Hu et al., 2014) as well as similarities of networks estimated based on data gathered with the same psychometric instruments (Bőthe et al., 2020; Fried et al., 2018; Hirota et al., 2020; Huang et al., 2020), we expect that four networks of work addiction estimated in this study would show a high level of replicability. Nevertheless, some differences are likely to be observed, and we expect that the most considerable differences would be observed between samples, including individuals with simultaneously different nationalities and sociodemographic backgrounds (e.g., Norwegians from the general working population and recent Polish university graduates).

Hypotheses

Based on theoretical considerations and previous research, we formulated the following hypotheses. Hypothesis 1: Work addiction networks would have a non-trivial topology, in which certain symptoms would be more tightly connected than others (the edge between salience and tolerance will be among the strongest edges). Hypothesis 2: Work addiction networks would replicate across samples, including working individuals from different countries and of diverse sociodemographic backgrounds.

Method

Participants and Procedure

The four samples used in this study were collected during previous research (Andreassen et al., 2016; Atroszko et al., 2016, 2017). Sample 1 and Sample 2 were gathered among working Norwegians, and Sample 3 and Sample 4 were gathered among working Poles. Individuals from Sample 1 and Sample 3 were from the general working population, and individuals from Sample 2 and Sample 4 were recent university graduates of younger age and different sociodemographics. Table 2 presents detailed characteristics of the four samples. Information about participants' compensation and deleted observations are presented in Supplemental Materials.

Table 2. Sociodemographic Characteristics of the Four Samples.

	Sample 1	Sample 2	Sample 3	Sample 4	Test of differences across samples
Description	General population	Recent graduates	General population	Recent graduates	
Nationality	Norwegian	Norwegian	Polish	Polish	
N	16,426	764	719	711	
Sex					$\chi^2(3) = 118.41$, $p < .001$
Female	10,487 (63.8%)	541 (70.8%)	509 (70.8%)	578 (81.3%)	
Male	5,939 (36.2%)	223 (29.2%)	200 (27.8%)	133 (18.7%)	
No answer	0 (0.0%)	0 (0.0%)	10 (1.4%)	0 (0.0%)	
Age (*M* [*SD*])	37.31 (11.36)	29.76 (7.12)	36.39 (11.36)	25.58 (3.41)	$F(3, 18{,}607) = 357.59$, $p < .001$
Age (range)	16–75	21–61	20–79	22–51	
Marital status					$\chi^2(3) = 21.44$, $p < .001$
In a relationship	11,831 (72.0%)	565 (74.0%)	567 (78.9%)	496 (69.8%)	
Not in a relationship	4,595 (28.0%)	199 (26.0%)	148 (20.6%)	215 (30.2%)	
No answer	0 (0.0%)	0 (0.0%)	4 (0.6%)	0 (0.0%)	
Number of children	NA				$\chi^2(8) = 386.84$, $p < .001$
0	NA	558 (73.0%)	290 (40.3%)	644 (90.6%)	
1	NA	82 (10.7%)	156 (21.7%)	51 (7.2%)	
2	NA	77 (10.1%)	168 (23.4%)	16 (2.3%)	
3	NA	29 (3.8%)	32 (4.5%)	0 (0.0%)	
4 or more	NA	18 (2.4%)	14 (1.9%)	0 (0.0%)	
No answer	NA	0 (0.0%)	59 (8.2%)	0 (0.0%)	
Highest completed education					$\chi^2(10) = 1{,}379.30$, $p < .001$
Primary school	782 (4.8%)	0 (0.0%)	NA	0 (0.0%)	
Vocational school	3,010 (18.3%)	0 (0.0%)	NA	0 (0.0%)	
High school	3,413 (20.8%)	29 (3.8%)[a]	NA	0 (0.0%)	
Bachelor's degree	6,045 (36.8%)	444 (58.1%)	NA	285 (40.1%)[b]	
Master's degree	2,933 (17.9%)	289 (37.8%)	NA	420 (59.1%)	
PhD	243 (1.5%)	2 (0.3%)	NA	6 (0.8%)	
Working hours per week (*M* [*SD*])	NA	37.45 (7.23)	45.53 (11.73)	39.76 (10.44)	$F(2, 2170) = 128.00$, $p < .001$
Working hours per week (Range)	NA	8–72	4–98	2–100	
Work status					$\chi^2(3) = 75.81$, $p < .001$
Full-time worker	12,961 (78.9%)	636 (83.2%)	640 (89.0%)	582 (82.9%)	
Part-time worker	3,465 (21.1%)	128 (16.8%)	61 (8.5%)	120 (17.1%)	
No answer	0 (0.0%)	0 (0.0%)	18 (2.5%)	0 (0.0%)	
Gross income (categories)[c,d]					
Category 1 (C1)	778 (4.7%)	15 (2.0%)	82 (11.4%)	82 (11.5%)	
Category 2 (C2)	941 (5.7%)	58 (7.6%)	116 (16.1%)	285 (40.1%)	
Category 3 (C3)	1,250 (7.6%)	318 (41.6%)	126 (17.5%)	197 (27.7%)	
Category 4 (C4)	3,035 (18.5%)	304 (39.8%)	79 (11.0%)	67 (9.4%)	
Category 5 (C5)	4,336 (26.4%)	39 (5.1%)	61 (8.5%)	24 (3.4%)	
Category 6 (C6)	2,675 (16.3%)	14 (1.8%)	24 (3.3%)	21 (3.0%)	
Category 7 (C7)	1,269 (7.7%)	1 (0.1%)	4 (0.6%)	7 (1.0%)	
Category 8 (C8)	768 (4.7%)	2 (0.3%)	8 (1.1%)	4 (0.6%)	
Category 9 (C9)	459 (2.8%)	0 (0.0%)	7 (1.0%)	0 (0.0%)	
Category 10 (C10)	270 (1.6%)	0 (0.0%)	2 (0.3%)	1 (0.1%)	
Category 11 (C11)	645 (3.9%)	0 (0.0%)	4 (0.6%)	4 (0.6%)	
No Answer	0 (0.0%)	13 (1.7%)	201 (28.0%)	19 (2.7%)	
Gross income (*M* [*SD*])[c]	NA	NA	46,079 PLN (33,054.24)	NA	

(continued)

Table 2. (continued)

	Sample 1	Sample 2	Sample 3	Sample 4	Test of differences across samples
Gross income (range)[c]	NA	NA	0–200,000 PLN	NA	
Subjective socioeconomic status (*M* [*SD*])	NA	4.74 (1.36)	NA	5.28 (1.43)	$t(1,448) = -7.29$, $p < .001$
Gathered	In the first half of 2014	In October and November of 2016	From January 2014 to July 2016	In October 2016	
Symptom severity (*M* [*SD*])	2.06 (0.33)	2.12 (0.42)	2.47 (0.36)	2.27 (0.37)	
More details in	Andreassen et al. (2016)	Atroszko et al. (2016)	Atroszko et al. (2017)	Atroszko et al. (2016)	

[a]These individuals completed a 1 year programme at a university (Årsenhet), which is incomparable with categories in other studies. To make their education level comparable, their highest completed level of education was recoded to high school.
[b]Seventeen individuals completed some kind of postgraduate studies, which is possible both after Bachelor's degree and Master's degree. To make their education level comparable, their highest completed level of education was recoded to Bachelor's degree.
[c]Past year personal annual income before tax in Norwegian and Polish currencies (i.e., NOK and PLN).
[d]Categories for gross income varied across samples. Sample 1: C1 = 0–99,999 NOK, C2 = 100,000–199,999 NOK, C3 = 200,000–299,999 NOK, C4 = 300,000–399,999 NOK, C5 = 400,000–499,999 NOK, C6 = 500,000–599,999 NOK, C7 = 600,000–699,999 NOK, C8 = 700,000–799,999 NOK, C9 = 800,000–899,999 NOK, C10 = 900,000–999,999 NOK, C11 = 1,000,999 NOK or more. Sample 2: C1 = 0–150,000 NOK, C2 = 150,001–300,000 NOK, C3 = 300,001–450,000 NOK, C4 = 450,001–600,000 NOK, C5 = 600,001–750,000 NOK, C6 = 750,001–900,000 NOK, C7 = 900,001–1,050,000 NOK, C8 = 1,050,001–1,200,000 NOK, C9 = 1,200,001–1,350,000 NOK, C10 = 1,350,001–1,500,000 NOK, C11 = 1,500,001 or more. Sample 3: The responses to the open-ended question were recoded to match the categories in Sample 4. Sample 4: C1 = 0–17,000 PLN, C2 = 17,001–34,000 PLN, C3 = 34,001–51,000 PLN, C4 = 51,001–68,000 PLN, C5 = 68,001–85,000 PLN, C6 = 85,001–102,000 PLN, C7 = 102,001–119,000 PLN, C8 = 119,001–136,000 PLN, C9 = 136,001–153,000 PLN, C10 = 153,001–170,000 PLN, C11 = 170,000 PLN or more.

Measures

The BWAS (Andreassen et al., 2012) measures each of the seven symptoms of work addiction with a single item (Brown, 1993; Griffiths, 2005; Leshner, 1997). Respondents rate how often during the past 12 months they experienced a given symptom. They provide responses on a 5-point Likert-type scale from 1 (*never*) to 5 (*always*). The measure does not have a skip-structure, and the obtained responses were not preprocessed. In Sample 1 and Sample 2, the Norwegian version of the scale was used (Andreassen et al., 2012). In Sample 3 and Sample 4, the Polish version of the scale was used (Atroszko et al., 2017). Both versions of the measure showed good validity in previous research (Andreassen et al., 2012; Atroszko et al., 2017). The Cronbach's alpha reliability coefficients were .86 for Sample 1, .85 for Sample 2, .84 for Sample 3, and .85 for Sample 4.

Additionally, participants from each sample reported their sex, age, marital status, work status, and gross income. In Sample 1, Sample 2, and Sample 4, gross income was measured with a closed-ended question with categories of different ranges (see Table 2). In Sample 3, gross income was measured with an open-ended question, which we recoded to categories from Sample 4 (see Table 2). Moreover, in Sample 2, Sample 3, and Sample 4, participants reported the number of children and the number of working hours per week. In Sample 1, Sample 2, and Sample 4, participants reported the highest completed level of education. In Sample 2 and Sample 4, the MacArthur Scale of Subjective Socioeconomic Status (Adler et al., 2000) was used to measure subjective socioeconomic status. This measure showed good validity and reliability in previous research (Operario et al., 2004).

Statistical Analyses

The analyses were performed using R version 4.0.5 (R Core Team, 2021) and the obtained networks were visualized using the qgraph 1.6.9 package (Epskamp et al., 2012). We divided the network analysis into the four steps introduced by Fried et al (2018): (1) network estimation, (2) network stability, (3) network inference, and (4) network comparison. For describing methods and results, we followed the guidelines for reporting psychological network analyses in cross-sectional data (Burger et al., 2023). The R code for all analyses and

the Supplemental Materials are available at https://osf.io/76kpw.

Network Estimation

We jointly estimated the four network of work addiction. The estimation was performed with a fused graphic lasso (FGL) method (designed for polychoric correlations) implemented in the EstimateGroupNetwork 0.3.1 package (Costantini & Epskamp, 2017). The optimal values of tuning parameters were selected sequentially via k-fold cross-validation. A seed was set to 1. We averaged the layouts of the four individually estimated networks to obtain a single layout for visualizations. We used a spin-glass algorithm implemented in the igraph 1.2.6 package (Csardi & Nepusz, 2006) to search for clusters of work addiction symptoms.

Network Stability

We investigated the stability of the four networks using the bootnet 1.4.7 package (Epskamp et al., 2018). To do so, we performed nonparametric bootstrapping and case bootstrapping based on 1,000 bootstrap samples. We evaluated the stability of the estimated networks based on the correlation stability coefficient, which represents "the maximum proportion of cases that can be dropped, such that with 95% probability the correlation between original centrality indices and centrality of networks based on subsets is 0.7 or higher" (Epskamp et al., 2018, p. 200). The network is described as acceptably stable when the correlation stability coefficient exceeds .25 and as stable when it exceeds .50 (Epskamp et al., 2018).

Network Inference

We estimated symptom centrality based on node strength. Node strength is the sum of absolute values of all edges connecting a node with other nodes in a network. To compare the four networks in terms of symptom centrality, we calculated Spearman correlation coefficients between node strength for each pair of networks.

We estimated the average predictability of symptoms using the mgm 1.2-11 package (Haslbeck, 2019). As this study comprises only ordinal data, node predictability indicates how much a node "can be predicted by all other nodes in the network, beyond what is trivially predicted by the marginal distribution" (Haslbeck & Waldorp, 2018, p. 856).

Network Comparison

We compared pairs of networks by calculating Spearman correlation coefficients of edge weights for each of the pairs and by using methods implemented in the NetworkComparisonTest 2.2.1 package (van Borkulo et al., 2017). We calculated and compared the global strength of each network ("the weighted absolute sum of all edges in the network"; van Borkulo et al., 2017, p. 16). Moreover, we investigated whether all edges of the two networks were identical. We always started with an omnibus test, and when the omnibus test was significant, we continued with the post hoc test (with the Holm-Bonferroni correction for multiple testing) which allowed us to identify the edges which were different between the two networks.

Results

Descriptive Statistics

Table 3 presents means, standard deviations, skewness, and kurtosis of the symptoms of work addiction in each sample. The levels of symptomatology differed across the four samples (see Table 3).

Network Estimation

The four networks estimated jointly for the four samples are visualized in Figure 1. The four networks were fully connected (i.e., all edges were different from zero). The mean absolute edge weights were equal to .13 in each of the four samples. The four networks featured many consistent edges, for example, Conflict (6)—Problems (7), but also some edges that considerably differed across the networks, for example, Withdrawal (5)—Conflict (6). The spin-glass algorithm showed that there were two clusters of symptoms, the first included Salience (1), Mood modification (3), and Withdrawal (5), and the second included Tolerance (2), Relapse (4), Conflict (6), and Problems (7).

Network Stability

Stability analyses indicated that all four networks were accurately estimated (the width of the confidence intervals around the edge weights was small to moderate). The correlation stability coefficients exceeded the recommended threshold of .50 for stability estimation for Network 1 (.75), Network 3 (.52), and Network 4 (.52), and exceeded the minimal threshold of .25 for Network 2 (.44; Epskamp et al., 2018).

Table 3. Overview of the Seven Symptoms of Work Addiction.

No.	Symptom	Skewness (Kurtosis)				*M* (*SD*)				Test of differences across samples
		Sample 1	Sample 2	Sample 3	Sample 4	Sample 1	Sample 2	Sample 3	Sample 4	
1	Salience	0.66 (2.47)	0.69 (2.59)	0.16 (2.05)	0.44 (2.30)	2.00 (1.02)	2.00 (0.99)	2.53 (1.13)	2.19 (1.01)	$F(3, 18{,}616) = 68.30$, $p < .001$
2	Tolerance	0.03 (2.17)	−0.01 (2.25)	−0.32 (2.31)	−0.09 (2.21)	2.67 (1.08)	2.74 (1.05)	3.18 (1.04)	2.85 (1.04)	$F(3, 18{,}616) = 55.08$, $p < .001$
3	Mood modification	1.30 (3.73)	1.49 (4.44)	0.60 (2.19)	0.95 (2.90)	1.70 (1.00)	1.59 (0.91)	2.18 (1.18)	1.93 (1.08)	$F(3, 18{,}616) = 66.57$, $p < .001$
4	Relapse	1.17 (3.45)	1.15 (3.45)	0.42 (2.04)	0.82 (2.53)	1.74 (0.99)	1.78 (1.02)	2.37 (1.21)	2.06 (1.19)	$F(3, 18{,}616) = 106.90$, $p < .001$
5	Withdrawal	0.70 (2.55)	0.47 (2.26)	0.59 (2.43)	0.78 (2.78)	2.05 (1.07)	2.24 (1.11)	2.23 (1.15)	1.99 (1.04)	$F(3, 18{,}616) = 14.24$, $p < .001$
6	Conflict	0.49 (2.16)	0.18 (2.19)	0.08 (1.89)	0.09 (1.97)	2.29 (1.19)	2.55 (1.12)	2.66 (1.23)	2.72 (1.22)	$F(3, 18616) = 59.29$, $p < .001$
7	Problems	0.86 (2.83)	0.92 (3.07)	0.57 (2.18)	0.74 (2.49)	1.97 (1.08)	1.92 (1.03)	2.17 (1.16)	2.13 (1.18)	$F(3, 18{,}616) = 12.83$, $p < .001$

Network Inference

Centrality analysis showed that Mood modification (3) had the lowest node strength and that Relapse (4) had the highest node strength in all networks (see Figure 2). Additionally, Salience (1) had systematically low node strength, Tolerance (2), Withdrawal (5), and Problems (7) had systematically high node strength, and Conflict (6) had relatively high variability of node strength across the networks. The node strength was substantially related across the four networks, with correlations ranging between .71 (Network 1 and Network 3) and .96 (Network 2 and Network 4).

Average predictability in the four networks ranged from 22.6% (Sample 2) to 28.3% (Sample 4) of variance remaining after excluding marginals. Whereas on average, marginals accounted for from 34.1% (Sample 3) to 44.1% (Sample 1; see Figure 1) of the whole variance. The most predictable symptom was Conflict (6), with an average value of 31.7% in the four networks, and the least predictable symptom was Mood modification (3), with an average value of 12.7% in the four networks. Average values of predictability for all other symptoms varied between 24.8 and 28.6%.

Network Comparison

Spearman correlation coefficients of edge weights for each pair of networks ranged from .93 (Networks 2 and 3) to .98 (Networks 1 and 2), indicating strong similarities between the networks (see the comments in the analytical code for details of all results related to network comparison). Global strength did not differ ($p > .05$) across the four networks, and its values were 2.99, 2.91, 2.83, and 2.86 for Network 1, Network 2, Network 3, and Network 4, respectively. In the omnibus tests of the six possible pairwise comparisons, four pairs of networks did not differ significantly from each other. Only Network 1 differed from Network 4 ($p < .001$), and Network 2 differed from Network 3 ($p = .030$), implying that these pairs of networks did not feature exactly the same 21 edge weights. The comparison of Network 1 and Network 4 revealed that of all 21 edges, only four edges (19.0%) differed significantly: Salience (1)—Relapse (4), Mood modification (3)—Withdrawal (5), Withdrawal (5)—Conflict (6), and Relapse (4)—Problems (7). The comparison of Network 2 and Network 3 revealed that of all 21 edges, only three edges (14.3%) differed significantly: Relapse (4)—Withdrawal (5), Salience (1)—Conflict (6), and Relapse (4)—Conflict (6).

Discussion

This study aimed to conceptualize work addiction as a dynamic system of symptoms that are in direct

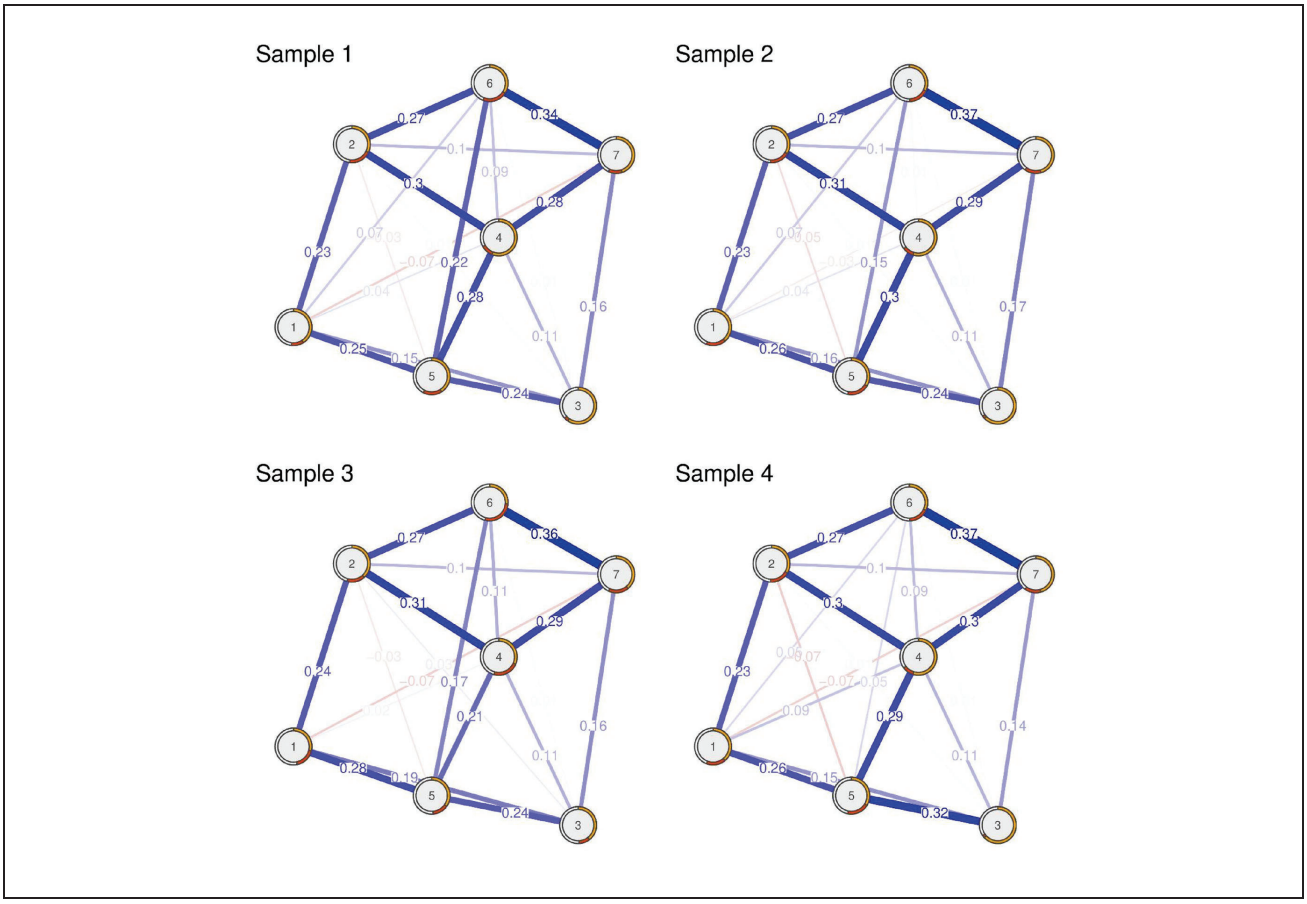

Figure 1. The four regularized partial correlation networks estimated jointly for the four samples. Positive edges are represented by blue lines and negative edges are represented by red lines. The strength of the relationship is represented by line thickness and darkness. Node predictability based on the marginal distribution of a node is represented by the orange area in the ring around a node. Node predictability based on the variance of a symptom explained by all of its neighbors is represented by the red area in the ring around a node. 1 = Salience; 2 = Tolerance; 3 = Mood modification; 4 = Relapse; 5 = Withdrawal; 6 = Conflict; 7 = Problems.

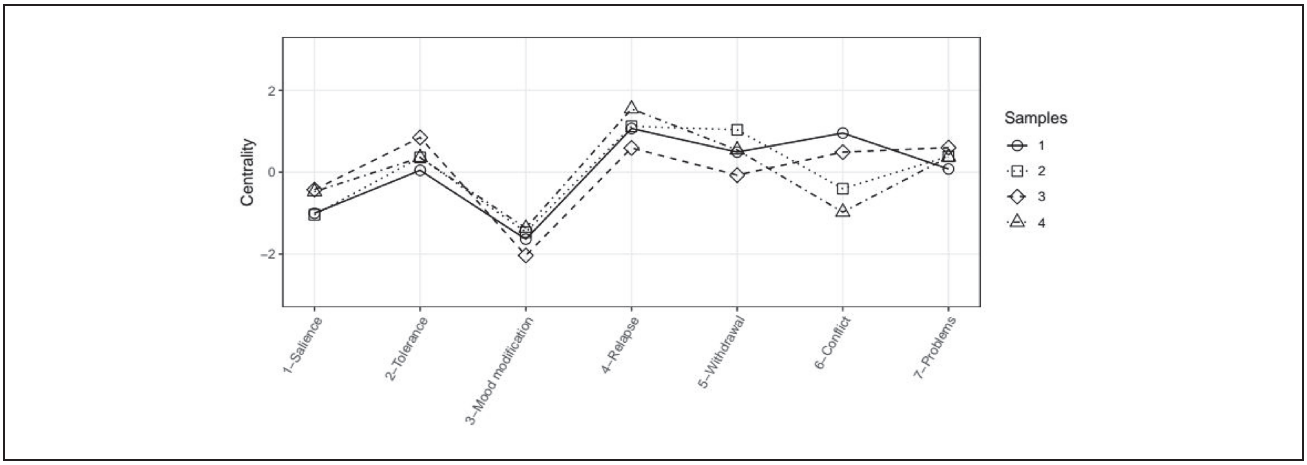

Figure 2. The standardized node strength of the seven work addiction symptoms in the four samples.

relationships with each other. We estimated the four networks based on the four samples that differed in terms of cultural background, age, sociodemographic background, and severity of symptomatology. The results showed that networks were stable and replicated across the four samples. While we observed differences between pairs of samples, including working individuals with simultaneously different nationalities and sociodemographic backgrounds, there was no clear pattern of differences in edge strengths across the two samples.

Strongest Edges and Clusters of Nodes

In each of the four networks, there were eight edges whose weights were greater than .20. These were: Salience (1)—Tolerance (2), Salience (1)—Withdrawal (5), Tolerance (2)—Relapse (4), Tolerance (2)—Conflict (6), Mood modification (3)—Withdrawal (5), Relapse (4)—Withdrawal (5), Relapse (4)—Problems (7), and Conflict (6)—Problems (7). These edges (along with weaker ones) were responsible for the existence of two clusters of work addiction symptoms, which may represent two partially independent self-sustaining processes. The first cluster included Salience (1), Mood modification (3), and Withdrawal (5). The second cluster included Tolerance (2), Relapse (4), Conflict (6), and Problems (7). The two clusters seem to partially resemble a distinction between core ("conflict, withdrawal symptoms, relapse and reinstatement and behavioral salience"; Charlton & Danforth, 2007, p. 1531) and peripheral ("cognitive salience, tolerance and euphoria"; Charlton & Danforth, 2007, p. 1531) symptoms previously identified in the case of gaming addiction (Charlton & Danforth, 2007).

The symptoms in the first cluster seem to represent the internal experiences of an individual, which are not easily observable by a bystander. This cluster may represent a process responsible mainly for the initial stage of work addiction. The process may start with the occurrence of negative states that an individual wants to escape. To escape the negative states, the individual develops a constant preoccupation with work (for example, constantly thinking about work). During short periods when the individual is not preoccupied with work, the initial negative states return, or the individual experiences withdrawal symptoms related to not working. These negative states once again activate salience, and the vicious cycle repeats. An intervention which may be helpful in breaking this cycle should focus on restructuring coping mechanisms used by the individual by reducing the role of work and increasing the roles of adaptive coping skills (Cossin et al., 2021).

The second cluster seems to represent a process responsible for the maintenance of work addiction. The process seems to start when an individual starts to feel the need to increase the "dosage." The increasing tolerance leads to the development of interpersonal and intrapersonal conflicts, which in turn result in health-related problems forcing the individual to reduce the amount of work. An attempt to reduce the amount of work is successful only for a short period and the whole cycle starts once again. To break this cycle, the possible interventions should focus on reducing the need to work longer. The interventions may involve cognitive restructuring of thoughts about work and/or encouragement to spend more time on leisure activities such as hobbies. These interventions may require support in the form of changes in labor laws and organizational culture such as mandatory vacation policy or limits on overtime work (Cossin et al., 2021). Moreover, it seems that a vicious cycle may be broken when the individual receives appropriate support when they find out about the health-related problems resulting from excessive work.

These two clusters of symptoms were connected mainly through the three edges: Salience (1)—Tolerance (2), Mood modification (3)—Problems (7), and Relapse (4)—Withdrawal (5). These edges seem to indicate that the two processes are not two completely independent and that while interventions on one of the clusters may break the vicious cycle for that cluster, the presence of symptoms from the other cluster may reinstate them. The activation of the second cluster seems to be possible mainly through the edge Salience (1)—Tolerance (2), which indicates that being preoccupied with work may lead to an increasing need to devote more time to work (the opposite direction seems possible as well). The activation of the first cluster seems to be also possible when an individual experiences withdrawal symptoms due to reducing the amount of work or when an individual experiences negative mental states because of health-related problems. The already mentioned interventions seem to address these paths adequately.

In light of previous research, it is important to point out that eight of the strongest edges in this study overlap with two out of the five strongest edges observed by Sun et al. (2023), and five out of seven correlations between residuals in previous research grounded in the latent variable framework (two of them overlapping with Sun et al., 2023; see Table 1). These results seem to indicate that both previous network studies and latent variable studies may constitute a valid source of hypotheses for future network studies of work addiction. However, while cross-cultural differences may explain some of the observed differences, additional investigations are needed to fully understand why two out of the eight strongest edges were not observed in either of the previous studies (please note that Relapse (4)—Withdrawal (5) was the sixth strongest edge in Sun et al., 2023, with edge weight equal to .16). Moreover, future studies should investigate the utility of

residual correlations as indicators of partial correlations in psychological networks as the former seems to be a potentially useful approximation of the latter.

Centrality and Predictability of Symptoms

The centrality and predictability of symptoms were rather similar across the four networks. The centrality indices of symptoms were ordered in a similar manner and the average predictabilities in each network were approximately 25%. However, there were meaningful differences between the centrality and predictability of symptoms.

Mood modification (3) showed the lowest centrality and predictability in the four networks. The low centrality may seem unexpected as addiction is often conceptualized as a result of a pathological mood modification strategy, and it could be argued that mood modification is crucial as an initial cause for other symptoms to occur (Atroszko, 2019a; Shaffer et al., 2004; Sussman, 2012). However, the low centrality may indicate that this symptom is present in the early stages of work addiction when it activates other symptoms. Still, it does not play such an important role when work addiction is fully developed and perpetuates. The low predictability may indicate that activation of mood modification is more dependent on external factors (e.g., adverse life events) than other symptoms of work addiction, which seems congruent with the addiction theory (Shaffer et al., 2004). Consequently, external factors with the highest probability of triggering mood modification symptoms may become targets of future prevention programs (Borsboom, 2017).

Relapse (4) showed the highest centrality in the four networks. It was measured as a response to a question of whether an individual was "told by others to cut down on work without listening to them" (Andreassen et al., 2012, p. 269). The high centrality and relatively high predictability indicate that this symptom is the most visible consequence of work addiction. In light of studies showing that more than 90% of addicted individuals do not recognize their problem or seek help (Goldstein et al., 2009), this result seems to indicate that the problem of individuals addicted to work is best identified when people close to them recognize and communicate their overinvolvement in work. As such it has implications for monitoring and studying work addiction, suggesting that observer ratings could be particularly useful in measuring work addiction in family settings, and in the workplace (Atroszko & Atroszko, 2020).

Different symptoms had the highest predictability in different networks, and in all networks, the symptoms had predictability between 20 and 40% (except for mood modification, whose predictability varied between 5 and 20%; see Figure 1). These results seem to indicate that the conceptualization of work addiction as a dynamic system of interacting symptoms is feasible. However, these results also indicate that while direct relationships between symptoms of work addiction may partially explain processes of development and maintenance of work addiction, they cannot be the sole reason for work addiction symptoms' existence and onset. This indicates that there most likely exists a common cause of work addiction symptoms (i.e., a latent variable) that co-exists with direct relationships between symptoms. Consequently, the use of statistical models accounting for the effects of latent variables and direct relationships between symptoms at the same time may be required to fully understand the processes responsible for the onset and maintenance of work addiction (see Epskamp et al., 2017).

Strengths and Limitations

We investigated four large samples comprising individuals of diverse cultural and sociodemographic backgrounds. The same instrument (the BWAS) was used in each sample. We jointly estimated the four networks and compared them quantitatively and qualitatively. Consequently, this study contributes to the still scant literature on the replicability of psychological networks; however, the generalizability of work addiction networks, based on different measures of work addiction, needs to be further investigated (Borsboom et al., 2017; Forbes et al., 2017a, 2017b).

In terms of limitations, the generalizability of the results needs to be considered as respondents represented general working populations from just two European countries, and females were overrepresented in each of the four samples. The validity of the results could have been influenced by the use of single-item measures of work addiction symptoms, which might have biased the estimates of networks' parameters. The causal inference was limited as the study design was cross-sectional. Finally, direct relationships between symptoms of work addiction could have been influenced by a lack of other important variables in the networks (e.g., work engagement or job burnout; Bereznowski, Atroszko, & Konarski, 2023; Bereznowski, Bereznowska, et al., 2023).

Conclusions and Future Studies Directions

This study showed that the network approach constitutes a promising framework for studying work addiction, as it may allow to identify processes responsible for the development and maintenance of work addiction. However, the network approach's impact on work addiction research should not be overestimated. The network framework allows to investigate direct relationships

between symptoms of work addiction easily, but a careful examination of previous research grounded in the latent variable framework may lead to somewhat similar observations (Atroszko et al., 2017; Bellali et al., 2023; Denizci Nazlıgül et al., 2022; Falco et al., 2022; Fekih-Romdhane et al., 2022; Molino et al., 2022). Additionally, the moderate level of symptom predictability indicates that a substantial portion of work addiction symptoms' variability cannot be predicted based on states of other symptoms. As a result, the latent variable framework seems to be the obvious complement of the network framework. Future research may require an integration of these two frameworks to understand work addiction fully.

The results of this study should be cross-validated by investigation of work addiction networks estimated based on other psychometric instruments, ideally comprising multiple items per each symptom of work addiction. Future studies should also investigate networks including work addiction and other work-related phenomena (and/or mental health problems), as well as networks based on longitudinal data and intensive longitudinal methods (e.g., experience sampling method). Moreover, future studies should investigate networks of work addiction among the clinical population and among populations from different cultures as well as search for sex, age, and work-related differences in networks of work addiction. Finally, the network approach may prove useful in clarifying the relationship between work addiction and anankastia/OCPD, which was suggested to be its major risk factor (Atroszko, 2019b; Atroszko et al., 2020).

Authors' Contribution

Piotr Bereznowski assisted with obtaining funding, literature search, study design and concept, statistical analyses, data interpretation, generation of the initial draft of the manuscript, manuscript preparation and editing, and final editing and approval of the manuscript; Paweł A. Atroszko assisted with literature search, study design and concept, data collection, data interpretation, generation of the initial draft of the manuscript, manuscript preparation and editing, and final editing and approval of the manuscript; Roman Konarski assisted with study design and concept, manuscript preparation and editing, and final editing and approval of the manuscript.

Declaration of Conflicting Interests

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Ethics Statement

The samples used in this study were gathered in three independent studies. All studies were carried out in accordance with the Declaration of Helsinki. In all cases, all gathered data was anonymous, and participants were informed about all the proper details about the study and their role in it, including that they can withdraw at any point. In all cases, attaining formal and written informed consent was not regarded as necessary as voluntary completion of the questionnaires was regarded as providing consent, and no medical information was gathered. The study collecting data for Sample 1 was approved by the Institutional Review Board of the Faculty of Psychology, University of Bergen, Norway. The study collecting data for Sample 2 and Sample 4 and the study collecting data for Sample 3 were approved by the Norwegian Data Protection Official for Research and the Research Ethics Committee at the Institute of Psychology, University of Gdańsk, Poland.

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Data Availability Statement

Data sharing not applicable to this article as no datasets were generated or analyzed during the current study.

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ORIGINAL ARTICLE

Work Addiction and Work Engagement: a Network Approach to Cross-Cultural Data

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Abstract

This study aimed to investigate direct relationships of work addiction symptoms with dimensions of work engagement. We used three samples in which work addiction was measured with the Bergen Work Addiction Scale and work engagement was measured with the Utrecht Work Engagement Scale. One sample comprised responses from working Norwegians ($n_1 = 776$), and two samples comprised responses from working Poles ($n_2 = 719$; $n_3 = 715$). We jointly estimated three networks using the fused graphic lasso method. Additionally, we estimated the stability of each network, node centrality, and node predictability and quantitatively compared all networks. The results showed that absorption and mood modification could constitute a bridge between work addiction and work engagement. It suggests that further investigation of properties of absorption and mood modification might be crucial for answering the question of how engaged workers become addicted to work.

Keywords Compulsive overworking · Network analysis · Network approach · Work addiction · Work engagement · Workaholism

The network approach to psychopathology (formalized as the network theory of mental disorders; Borsboom, 2017) has become a popular framework for studying mental disorders (Contreras et al., 2019; Fried et al., 2017; Robinaugh et al., 2020). Recently, it has been used to conceptualize work addiction as a dynamic system of symptoms in direct relationships (Bereznowski et al., 2021). This paper aims to extend the previous work by investigating direct relationships of work addiction symptoms with dimensions of work

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engagement in three samples with diverse cultural and sociodemographic backgrounds (one Norwegian sample and two Polish samples).

The Network Approach to Psychological Data

A network is a graph consisting of nodes and edges. Nodes represent observed variables (e.g., a symptom of work addiction or a dimension of work engagement). Edges represent direct relationships between nodes estimated from data (e.g., partial correlation coefficients). Network analysis is a multistep process of analyzing a pattern of edges present in the network (Epskamp et al., 2018). The first step includes investigating which edges connect nodes, whether the edges are positive or negative, how strong they are, and search for clusters of nodes in the network (i.e., groups of strongly connected nodes). The second step includes investigating the stability of estimated networks which indicates whether a third step (network inference) is warranted. The third step includes an investigation of node centrality (i.e., how strongly a node could influence and/or be influenced by all other nodes in the network; Epskamp et al., 2018) and node predictability (i.e., how much a node can be predicted by all the other nodes in the network; Haslbeck & Waldorp, 2018). The fourth step (performed only when several networks were estimated) includes an investigation of the difference between the estimated networks. According to the network theory of mental disorders, the results of network analysis could provide information for the development of treatment and prevention programs (Borsboom, 2017).

The Network Approach to Work Addiction

A recent debate showed that there is a consensus between experts that compulsive overworking is a genuine problem (Andreassen et al., 2018; Atroszko et al., 2019; Griffiths et al., 2018; Kun, 2018; Lior et al., 2018; Malinowska, 2018; Quinones, 2018; Sussman, 2018; Tóth-Király et al., 2018). Over the years, several conceptualizations of this phenomenon were proposed in the literature (e.g., Clark et al., 2020; Loscalzo & Giannini, 2018; Snir & Harpaz, 2012; Vallerand et al., 2010), including the one conceptualizing compulsive overworking within a behavioral addictions framework and labeling it work addiction (Griffiths, 2011; Griffiths et al., 2018). The work addiction conceptualization is based on a common addiction components model (Brown, 1993; Griffiths, 2005), which includes seven addiction symptoms.

As the interpretation of network analysis is inseparably tied to the operationalization and measurement (Burger et al., 2020; Fried, 2017; see also Malgaroli et al., 2021; Rodebaugh et al., 2018), we devote the following paragraph to describe the seven symptoms of work addiction in detail. *Salience* (1) refers to the constant preoccupation with work, which manifests itself in the dominance of work in the individual's thoughts, feelings, and behavior. *Tolerance* (2) refers to the need to increase the amount of work to achieve the previous mood modification effects and means that the individual gradually increases the amount of time spent every day working. *Mood modification* (3) refers to the subjective experience that working allows the individual to escape the negative states that he/she is experiencing (e.g., anxiety, guilt, or hopelessness) or to experience the arousing "high" associated with working. *Relapse* (4) refers to the repeated reversions to earlier patterns of excessive working (which are quickly restored even for the most extreme patterns) after periods of control.

Withdrawal (5) refers to the unpleasant affective states and/or physical effects when the individual is unable to work. *Conflict* (6) refers to the conflicts between the individual and those around them, the conflicts between work and other activities such as social life and hobbies, and intrapsychic conflicts such as incompatible needs. *Problems (7)* component refers to the health and/or other problems resulting from excessive working (Andreassen et al., 2012; Griffiths, 2011).

A previous study showed that the pattern of direct relationships between symptoms of work addiction was almost identical for individuals of diverse cultural and sociodemographic backgrounds (Bereznowski et al., 2021). In each of the four networks, the most central symptom was relapse, and the least central symptom was mood modification. Additionally, each network of work addiction comprised two clusters of symptoms, which showed partial overlap with a distinction between core and peripheral addiction criteria distinguished for gaming addiction (Charlton & Danforth, 2007). In the case of gaming addiction, the core criteria were conflict, withdrawal symptoms, relapse and reinstatement, and behavioral salience, and the peripheral criteria were cognitive salience, tolerance, and euphoria (Charlton & Danforth, 2007). In the case of work addiction, the first cluster included tolerance, relapse, conflict, and problems, and the second cluster included salience, mood modification, and withdrawal. Taking into account that the same addiction symptoms might have somewhat different diagnostic properties in the case of different behaviors (for differences in diagnostic properties of symptoms between work addiction and gaming addiction, see Bereznowski and Konarski (2020) and Khazaal et al. (2018)), these results could indicate that the two clusters represent groups of more (tolerance, relapse, conflict, and problems) and less (salience, mood modification, and withdrawal) pathological symptoms of work addiction. Based on this premise and the positive characteristic of work engagement (Schaufeli et al., 2002), we argue that the less pathological symptoms of work addiction would have direct positive relationships with some dimensions of work engagement in the network of work addiction and work engagement.

Work Addiction and Work Engagement

The most widely adopted conceptualization of work engagement is the one proposed by Schaufeli et al. (2002), which defines work engagement as a work-related mental state characterized by vigor, dedication, and absorption (Bailey et al., 2017). *Vigor* (1) refers to "high levels of energy and mental resilience while working, the willingness to invest effort in one's work, and persistence even in the face of difficulties" (Schaufeli et al., 2002, p. 74). *Dedication* (2) refers to "a sense of significance, enthusiasm, inspiration, pride, and challenge" (Schaufeli et al., 2002, p. 74). *Absorption* (3) refers to "being fully concentrated and deeply engrossed in one's work, whereby time passes quickly and one has difficulties with detaching oneself from work" (Schaufeli et al., 2002, p. 75).

Work engagement and compulsive overworking are two different subtypes of heavy work investment (Harpaz & Snir, 2014), which are similar on the surface but differ in terms of motivation, antecedents, and consequences (Clark & Michel, 2014; Taris et al., 2014; detailed discussion of similarities and differences between these two phenomena is beyond the scope of this paper; for an elaborated comparison between compulsive overworking and work engagement, we refer the reader to Harpaz and Snir (2014)). While work engagement is regarded as a positive and fulfilling mental state, it also is weakly positively associated with compulsive overworking (Clark et al., 2016; Di Stefano & Gaudiino, 2019). The

two recent meta-analyses revealed that this relationship is a result of a weak positive relationship between compulsive overworking and a single dimension of work engagement—absorption (Clark et al., 2016; Di Stefano & Gaudiino, 2019). However, these two studies used somewhat different methodologies, and their results point to some important issues in the measurement of work addiction and work engagement.

The first difference between the two meta-analyses was that Clark et al. (2016) included all studies focused on the relationship between work addiction and work engagement irrespectively of used instruments, while Di Stefano and Gaudiino (2019) included in the meta-analysis only studies which measured work addiction with the Dutch Work Addiction Scale (DUWAS; Schaufeli et al., 2006, 2008) and work engagement with the Utrecht Work Engagement Scale (UWES; Schaufeli et al., 2002, 2006). The second difference between the two meta-analyses was that Clark et al. (2016) combined correlation coefficients of different dimensions of work addiction with work engagement dimensions in a single study into a composite, while Di Stefano and Gaudiino (2019) differentiated between working excessively and working compulsively. Clark et al. (2016) showed that work addiction was weakly positively correlated with general work engagement (estimated *r* equaled 0.05), absorption (estimated *r* equaled 0.09), and nonsignificantly correlated with vigor and dedication (estimated *r*s equaled –0.01 and 0.03, respectively). Di Stefano and Gaudiino (2019) showed that working compulsively was weakly positively correlated with absorption (estimated *g* equaled 0.28 (after converging effect sizes *r* equaled 0.15)) and nonsignificantly correlated with vigor and dedication (estimated *g*s equaled 0.01 and –0.02, respectively (after converting effect sizes *r*s equaled 0.01 and –0.02, respectively)). Working excessively was weakly positively correlated with absorption and dedication (estimated *g*s equaled 0.34 and 0.14, respectively (after converting effect sizes *rs* equaled 0.17 and 0.09)), and nonsignificantly correlated with vigor (estimated *g* equaled 0.04 (after converting effect sizes *r* equaled 0.02)). These results show that a nuanced approach to investigating the relationship between work addiction and components of work engagement is indispensable to properly capture the nature of these phenomena.

The positive relationship between work addiction and work engagement is a matter of high-intensity working shared between these two phenomena which presents itself in the content overlap between absorption and some symptoms of work addiction (Di Stefano & Gaudiino, 2019). Based on a model of micro-, meso-, and macro-level risk factors (Atroszko et al., 2020), we argue that among vulnerable individuals (e.g., highly perfectionistic) under certain external circumstances (for example, when an individual experiences high workplace stress, a work-family conflict, or have unsatisfying personal relationships), this shared component of high-intensity working and being engrossed in work could lead to developing work addiction. This process could be observed at the symptom level of work addiction. Consequently, in this study, we used a network approach to investigate relationships between symptoms of work addiction and components of work engagement.

Based on the following part of the absorption definition "one has difficulties with detaching oneself from work" (Schaufeli et al., 2002, p. 75), the content overlap probably involves salience (constant preoccupation with work), tolerance (working longer than initially intended), withdrawal (unpleasant affective states when the individual is unable to work), and conflict (conflicts between the work and other activities such as social life and hobbies). This overlap would be observed in the networks of work addiction and work engagement as direct relationships between absorption and the four symptoms of work addiction. The presence of these relationships could provide further insights into how engaged workers become addicted to work, and approaching this issue using the network theory framework could contribute to the development of prevention programs based on quantitative evidence (Borsboom, 2017).

However, it should be noted that even though results of cross-sectional partial correlation networks could reflect within-subject relationships (see Rodebaugh et al. (2018) and von Klipstein et al. (2021)), longitudinal studies are highly warranted to confirm their results.

The Present Study

The three samples we used in this study are the same samples that Bereznowski et al. (2021) used to investigate direct relationships between symptoms of work addiction. For this reason, our result regarding direct relationships between symptoms of work addiction would closely reflect the results reported by Bereznowski et al. (2021) and should not be taken as novel results; therefore, they will not be discussed in this work.

This study focused on investigating direct relationships between symptoms of work addiction and dimensions of work engagement. We will start by estimating three networks of work addiction and work engagement in which edges between pairs of nodes (a node is either a symptom of work addiction or a dimension of work engagement) would indicate direct relationships between these nodes. Further, we would estimate the stability of these networks and investigate node centrality (indicating how strongly a node could influence and/or be influenced by all other nodes in the network) and node predictability (indicating how much all of its neighbors can predict a node) of all nodes in the networks. Finally, we would compare the three networks and estimate a combined cross-sample network to highlight similarities between the networks and a cross-sample variability network to highlight differences between the networks.

Hypotheses

Based on previous empirical research and theoretical considerations, we formulated the following hypotheses. Hypothesis 1: The networks of work addiction and work engagement would have three clusters of nodes (cluster 1, dimensions of work engagement; cluster 2, salience, mood modification, and withdrawal; cluster 3, tolerance, relapse, conflict, and problems). Hypothesis 2: Cluster 1 would be connected with cluster 2 and cluster 3 via direct relationships between absorption and salience, tolerance, mood modification, withdrawal, and conflict. Based on completely positive characteristics of vigor and dedication and the results of previous studies (Clark et al., 2016; Di Stefano & Gaudiino, 2019), we do not expect any direct relationships between these two dimensions of work engagement and symptoms of work addiction. Hypothesis 3: Due to numerous direct relationships with symptoms of work addiction, absorption would be a central node in the network of work addiction and work engagement, and it would constitute a bridge between the two phenomena.

Method

Participants and Procedure

In this study, we used three samples from research focusing on work addiction; one included responses of working Norwegians (sample 1), and two included responses of working Poles (sample 2 and sample 3). One sample included the general working

population (sample 2), and two samples included individuals of considerably younger age (sample 1 and sample 3). The latter samples were recruited for a longitudinal study on work addiction when they were studying at a university in 2013. The analyses included their responses after they graduated and begun working professionally. Their young age and early stage of career are related to important differences in terms of socioeconomic status (education, all university graduates; salary, lower salaries; job position, less likely to have managerial positions; wealth, less likely to accumulate wealth) in comparison to the general working population including older participants (on average more than 10 years older) who most notably were not all university graduates.

Table 1 presents detailed sociodemographic characteristics of the three samples after the listwise deletion of observations with missing data on work addiction or work engagement and their statistical comparison. The three samples differed significantly in terms of all sociodemographic characteristics. Sample 3 included a higher proportion of women (81.6%) than sample 1 (71.0%) and sample 2 (70.6%). The mean age of participants was the highest in sample 2 ($M = 36.24$) and the lowest in sample 3 ($M = 25.58$). The highest proportion of individuals in a relationship was in sample 2 (78.7%) and the lowest ratio was in sample 3 (70.2%). Sample 2 included the highest proportion of individuals with children (58.9%), and sample 3 included the lowest proportion of individuals with children (9.5%). Most individuals in sample 1 had a bachelor's degree (57.9%), and most individuals in sample 3 had a master's degree (59.1%); individuals in sample 2 were not asked about their education. Mean working hours per week were the highest in sample 2 ($M = 45.61$) and the lowest in sample 1 ($M = 37.48$). Sample 2 included a higher proportion of individuals working full-time (89.2%) than sample 1 (83.3%) and sample 3 (83.2%). Individuals in sample 3 had a higher level of subjective socioeconomic status ($M = 5.28$) than individuals in sample 1 ($M = 4.74$); individuals in sample 2 were not asked about their subjective socioeconomic status. Detailed information regarding compensation, missing data, and removal of observations with missing data are presented in the Supplemental Materials.

Measures

Work Addiction

The Bergen Work Addiction Scale (BWAS; Andreassen et al., 2012) consists of seven items based on the seven symptoms of addiction (Brown, 1993; Griffiths, 2005; Leshner, 1997). Each item asks respondents how often they experienced a given symptom during the past 12 months (e.g., "How often during the last year have you worked in order to reduce feelings of guilt, anxiety, helplessness and depression?" measures mood modification and "How often during the last year have you worked so much that it has negatively influenced your health?" measures tolerance). The responses are provided on a 5-point Likert scale ranging from 1 (*never*) through 2 (*rarely*), 3 (*sometimes*), 4 (*often*), to 5 (*always*). This measure does not have a skip-structure, and we did not preprocess the obtained responses in any way. The Norwegian version of the scale was used in sample 1, and the Polish version of the scale was used in sample 2 and sample 3. The BWAS showed good content validity, convergent validity, and criterion validity in previous studies (for the evidence of the validity of the Norwegian version of the BWAS, see Andreassen et al. (2014), Andreassen et al. (2016), and Andreassen et al. (2019); for the evidence of the validity of the Polish version of the BWAS, see Atroszko et al. (2017)). The Cronbach's alpha reliability coefficients were 0.85 for sample 1, 0.84 for sample 2, and 0.84 for sample 3.

Table 1 Sociodemographic characteristics of the three samples

	Sample 1	Sample 2	Sample 3	Test of differences between samples
Description	Recent graduates	General population	Recent graduates	
Nationality	Norwegian	Polish	Polish	
N	755	701	697	
Sex				$\chi^2(2) = 26.64, p < .001$
Female	536 (71.0%)	495 (70.6%)	569 (81.6%)	
Male	219 (29.0%)	196 (28.0%)	128 (18.4%)	
No answer	0 (0.0%)	10 (1.4%)	0 (0.0%)	
Age (*M* [*SD*])	29.77 (7.15)	36.24 (11.30)	25.58 (3.41)	$F(2, 2142) = 318.8, p < .001$
Age (range)	21–61	20–79	22–51	
Marital status				$\chi^2(2) = 15.05, p < .001$
In a relationship	560 (74.2%)	552 (78.7%)	489 (70.2%)	
Not in a relationship	195 (25.8%)	145 (20.7%)	208 (29.8%)	
No answer	0 (0.0%)	4 (0.6%)	0 (0.0%)	
Number of children				$\chi^2(8) = 366.44, p < .001$
0	552 (73.1%)	288 (41.1%)	631 (90.5%)	
1	80 (10.6%)	154 (22.0%)	51 (7.3%)	
2	76 (10.1%)	156 (22.3%)	15 (2.2%)	
3	29 (3.8%)	32 (4.6%)	0 (0.0%)	
4 or more	18 (2.4%)	14 (2.0%)	0 (0.0%)	
No answer	0 (0.0%)	57 (8.1%)	0 (0.0%)	
Highest completed education				$\chi^2(3) = 86.04, p < .001$
Primary school	0 (0.0%)	NA	0 (0.0%)	
Vocational school	0 (0.0%)	NA	0 (0.0%)	
High school	29 (3.8%)[a]	NA	0 (0.0%)	
Bachelor's degree	437 (57.9%)	NA	279 (40.0%)[b]	
Master's degree	287 (38.0%)	NA	412 (59.1%)	
PhD	2 (0.3%)	NA	6 (0.9%)	

Table 1 (continued)

	Sample 1	Sample 2	Sample 3	Test of differences between samples
Working hours per week (*M* [*SD*])	37.48 (7.24)	45.61 (11.75)	39.69 (10.26)	$F(2, 2130) = 129.53$, $p < .001$
Working hours per week (range)	8–72	4–98	2–85	
Work status				$\chi^2(2) = 25.19$, $p < .001$
Full-time worker	629 (83.3%)	625 (89.2%)	580 (83.2%)	
Part-time worker	126 (16.7%)	59 (8.4%)	117 (16.8%)	
No answer	0 (0.0%)	17 (2.4%)	0 (0.0%)	
Gross income (categories)[cd]				
Category 1 (C1)	15 (2.0%)	81 (11.6%)	82 (11.8%)	
Category 2 (C2)	58 (7.7%)	115 (16.4%)	285 (40.9%)	
Category 3 (C3)	317 (42.0%)	120 (17.1%)	197 (28.3%)	
Category 4 (C4)	304 (40.3%)	76 (10.8%)	67 (9.6%)	
Category 5 (C5)	39 (5.2%)	61 (8.7%)	24 (3.4%)	
Category 6 (C6)	14 (1.9%)	24 (3.4%)	21 (3.0%)	
Category 7 (C7)	1 (0.1%)	4 (0.6%)	7 (1.0%)	
Category 8 (C8)	2 (0.3%)	8 (1.1%)	4 (0.6%)	
Category 9 (C9)	0 (0.0%)	6 (0.9%)	0 (0.0%)	
Category 10 (C10)	0 (0.0%)	2 (0.3%)	1 (0.1%)	
Category 11 (C11)	0 (0.0%)	4 (0.6%)	4 (0.6%)	
No answer	5 (0.7%)	200 (28.5%)	5 (0.7%)	
Gross income (*M* [*SD*])[c]	NA	46 029.08 (33 104.21) PLN	NA	
Gross income (range)[c]	NA	0–200 000 PLN	NA	
Subjective socioeconomic status (*M* [*SD*])	4.74 (1.37)	NA	5.28 (1.43)	$t(1447) = -7.29$, $p < 0.001$
Gathered	In October and November of 2016	From January 2014 to July 2016	In October 2016	
Symptom severity (*M* [*SD*])	2.12 (0.75)	2.48 (0.83)	2.27 (0.80)	
Work engagement (*M* [*SD*])	15.30 (3.51)	14.50 (3.86)	14.10 (3.65)	

Table 1 (continued)

	Sample 1	Sample 2	Sample 3	Test of differences between samples
More details in	Atroszko et al. (2016)	Atroszko et al. (2017)	Atroszko et al. (2016)	

[a]These individuals declared that their highest completed level of education is a 1-year program at a university (i.e., Årsenhet in Norwegian; this level of education is incomparable with categories in other studies); therefore, we classified all of them as individuals whose highest completed level of education is high school

[b]Seventeen individuals declared that their highest completed level of education is some kind of postgraduate studies which can be completed both after bachelor's degree and master's degree (this level of education is incomparable with categories in other studies); therefore, we classified all of them as individuals whose highest completed level of education is bachelor's degree

[c]Past year personal annual income before tax in Norwegian and Polish currencies (i.e., NOK and PLN). [d]Categories for gross income varied between samples. In sample 1: C1 = 0–150 000 NOK, C2 = 150 001–300 000 NOK, C3 = 300 001–450 000 NOK, C4 = 450 001–600 000 NOK, C5 = 600 001–750 000 NOK, C6 = 750 001–900 000 NOK, C7 = 900 001–1 050 000 NOK, C8 = 1 050 001–1 200 000 NOK, C9 = 1 200 001–1 350 000 NOK, C10 = 1 350 001–1 500 000 NOK, C11 = 1 500 001 or more. In sample 2, the open response on gross income was recoded to match categories in sample 3. In sample 3: C1 = 0–17 000 PLN, C2 = 17 001–34 000 PLN, C3 = 34 001–51 000 PLN, C4 = 51 001–68 000 PLN, C5 = 68 001–85 000 PLN, C6 = 85 001–102 000 PLN, C7 = 102 001–119 000 PLN, C8 = 119 001–136 000 PLN, C9 = 136 001–153 000 PLN, C10 = 153 001–170 000 PLN, C11 = 170 000 PLN or more

Work Engagement

The 9-item version of the Utrecht Work Engagement Scale (UWES-9; Schaufeli et al., 2006) consists of nine items, three for each dimension of work engagement: vigor (e.g., "At my work, I feel bursting with energy."), dedication (e.g., "I am enthusiastic about my job."), and absorption (e.g., "I am immersed in my work."). Each item asks respondents how often they experienced a described state during their lifetime. The responses are provided on a 7-point Likert scale ranging from 1 (*never*) through 2 (*a few times a year or less*), 3 (*once a month or less*), 4 (*a few times a month*), 5 (*once a week*), 6 (*a few times a week*), to 7 (*everyday*). This measure does not have a skip-structure, and we did not preprocess the obtained responses in any other way than obtaining a sum of three items for each dimension. The Norwegian version of the scale was used in sample 1, and the Polish version of the scale was used in sample 2 and sample 3. The UWES showed good content validity, convergent validity, and criterion validity in previous studies (Schaufeli et al., 2006); however, there is mixed support for its factorial validity in different countries (for the evidence of the validity of the Norwegian version of the UWES, see Nerstad et al. (2010); for the evidence of the validity of the Polish version of the UWES, see Kulikowski (2019)). The Cronbach's alpha reliability coefficients were 0.89 (vigor), 0.89 (dedication), and 0.84 (absorption) for sample 1; 0.85 (vigor), 0.82 (dedication), and 0.78 (absorption) for sample 2, and 0.84 (vigor), 0.80 (dedication), and 0.76 (absorption) for sample 3.

Sociodemographic Characteristics

In each sample, participants were asked about sex, age, marital status, working hours per week, work status, and gross income (i.e., past year personal annual income before tax). In the case of gross income, participants in sample 1 and sample 3 were asked a closed-ended question with different income ranges for each category in each sample (see Table 1), and participants in sample 2 were asked an open-ended question about their last year's income. Additionally, participants in sample 1 and sample 3 were asked about the highest completed level of education and subjective socioeconomic status measured with the MacArthur Scale of Subjective Socioeconomic Status (Adler et al., 2000), which showed good validity and reliability in previous research (Operario et al., 2004).

Statistical Analyses

All analyses were carried out with R version 4.0.5 (R Core Team, 2021) and visualized with the qgraph 1.6.9 package (Epskamp et al., 2012). For estimating networks from multiple samples, we followed the four steps described by Fried et al. (2018): (a) network estimation, (b) network stability, (c) network inference, and (d) network comparison. We followed the reporting standards for psychological network analyses in cross-sectional data set by Burger et al. (2020) for reporting the results. Some important but not essential parts of the "Method" and the "Results" sections (e.g., individually estimated networks and bootstrapped values of edge weights) are available in the Supplemental Materials. The analytic code for all analyses performed in this study and the Supplemental Materials are available at https://osf.io/r693u/.

Network Estimation

To jointly estimate the three networks, we used the fused graphic lasso (FGL) method and the EstimateGroupNetwork 0.3.1 package (Costantini & Epskamp, 2017). The optimal values of λ_1 (a tuning parameter regulating the density penalty) and λ_2 (a tuning parameter regulating the penalty on differences among corresponding edge weights between networks from different samples) were selected sequentially via k-fold cross-validation with seed set to 1. A layout for visualizations was obtained via averaging the layouts for the three individually estimated networks. To search for clusters of nodes within the three networks, we used a spin-glass algorithm implemented in the igraph 1.2.6 package (Csardi & Nepusz, 2006).

Network Stability

To investigate the stability of the three networks, we used the bootnet 1.4.7 package (Epskamp et al., 2018), using nonparametric bootstrapping and case bootstrapping based on 1000 bootstrap samples, which estimates stability based on individually estimated networks. As a measure of network stability, we used the correlation stability coefficient, which represents the maximum proportion of cases that can be dropped, such that with 95% probability, the correlation between original centrality measures and centrality of networks based on subsets is 0.70 or higher. A correlation stability coefficient higher than 0.50 is regarded as an indicator of good stability, and a correlation stability coefficient higher than 0.25 is regarded as an indicator of acceptable stability (Epskamp et al., 2018).

Network Inference

We estimated node centrality based on the node strength. A standard version of the node strength is a metric equal to the sum of absolute values of all edges of a given node to all other nodes. We argue that the standard version of the node strength could poorly identify bridge nodes when tightly connected clusters of nodes are weakly connected with each other. Therefore, we created a modified version of the node strength which should better capture bridge nodes in this special case; we call it a bridge strength. The bridge strength is a metric equal to the sum of absolute values of all edges of a given node to all other nodes which represent different psychological phenomenon (e.g., for absorption, this is the sum of absolute values of all edges which absorption has with work addiction symptoms). To compare the three networks in terms of node centrality, we calculated Spearman correlation coefficients between both versions of the node strength for the three pairs of networks.

To estimate the predictability of nodes, we used the mgm 1.2–11 package (Haslbeck, 2019), which estimates predictability based on individually estimated networks. For continuous data (dimensions of work engagement), node predictability indicates the percentage of variance explained by all of its neighbors (R^2). For ordinal data (symptoms of work addiction), node predictability indicates how much a node can be predicted by all of its neighbors, beyond what is trivially predicted by the marginal distribution of this node (for a detailed explanation, see Haslbeck and Waldorp (2018)).

Network Comparison

To compare pairs of networks, we calculated Spearman correlation coefficients of edge weights for each pair of networks and used the NetworkComparisonTest 2.2.1 package (van Borkulo et al., 2017) with seed set to 1. Using the NetworkComparisonTest package, we performed the omnibus test, which allows investigating whether all edges of the two networks are identical. When the omnibus test was statistically significant, we performed the post hoc test (which uses the Holm-Bonferroni method to correct for multiple testing) to investigate which edges weights were different between the two networks. Finally, regardless of previous results and for the sake of future comparisons, we calculated the global strength estimates (the sum of all absolute edge weights for each network) and tested whether they differed between networks.

To highlight the similarities between the three networks, we estimated a cross-sample network (obtained by pooling all observations into one sample) and used it to calculate the standard version of the node strength, the bridge strength, and node predictability. To highlight the differences between the three networks, we estimated a cross-sample variability network in which each edge represents the standard deviation of this edge between the three networks (see Fried et al. (2018)).

Results

Descriptive Statistics

Means, standard deviations, skewness, and kurtosis of the seven symptoms of work addiction and the three dimensions of work engagement in the three samples are presented in Table 2. The three populations differed significantly in terms of severity of symptomatology and levels of work engagement (see Table 2).

Network Estimation

The three networks estimated jointly for the three samples are visualized in Fig. 1. The network density equaled 0.93 (42/45 edges) for network 1, 0.89 (40/45 edges) for network 2, and 0.87 (39/45 edges) for network 3. The mean absolute edge weights equaled 0.11, 0.10, and 0.10 for network 1, network 2, and network 3, respectively. The spin-glass algorithm identified the same three clusters in the three networks. The first cluster included salience (1), mood modification (3), and withdrawal (5). The second cluster included tolerance (2), relapse (4), conflict (6), and problems (7). The third cluster included vigor (V), dedication (D), and absorption (A). The cluster of work engagement was connected with the clusters of work addiction by several consistent edges (see Fig. 1). The strongest positive edges were withdrawal (5)—absorption (A), mood modification (3)—absorption (A), and salience (1)—absorption (A). The strongest negative edges were mood modification (3)—dedication (D), problems (7)—vigor (V), and conflict (6)—vigor (V).

Table 2 Overview of the Seven Symptoms of Work Addiction and the Three Dimensions of Work Engagement

No	Node	Skewness (kurtosis)			*M* (*SD*)			Test of differences between samples
		Sample 1	Sample 2	Sample 3	Sample 1	Sample 2	Sample 3	
1	Salience	0.69 (2.59)	0.14 (2.04)	0.44 (2.29)	2.00 (0.99)	2.54 (1.13)	2.19 (1.01)	$F(2, 2150) = 50.61$, $p < 0.001$
2	Tolerance	−0.01 (2.25)	−0.33 (2.33)	−0.10 (2.21)	2.74 (1.05)	3.18 (1.04)	2.86 (1.04)	$F(2, 2150) = 34.81$, $p < 0.001$
3	Mood modification	1.49 (4.44)	0.58 (2.18)	0.96 (2.92)	1.59 (0.91)	2.19 (1.19)	1.93 (1.08)	$F(2, 2150) = 57.70$, $p < 0.001$
4	Relapse	1.16 (3.47)	0.42 (2.05)	0.82 (2.53)	1.78 (1.02)	2.37 (1.21)	2.07 (1.19)	$F(2, 2150) = 48.46$, $p < 0.001$
5	Withdrawal	0.47 (2.25)	0.58 (2.40)	0.78 (2.78)	2.24 (1.11)	2.24 (1.16)	1.99 (1.04)	$F(2, 2150) = 11.60$, $p < 0.001$
6	Conflict	0.18 (2.20)	0.07 (1.89)	0.09 (1.96)	2.54 (1.12)	2.67 (1.23)	2.73 (1.23)	$F(2, 2150) = 4.65$, $p = 0.010$
7	Problems	0.93 (3.09)	0.56 (2.16)	0.75 (2.51)	1.92 (1.03)	2.18 (1.16)	2.13 (1.18)	$F(2, 2150) = 10.66$, $p < 0.001$
8	Vigor	−0.74 (3.25)	−0.55 (2.51)	−0.31 (2.43)	15.40 (3.74)	14.32 (4.20)	13.50 (3.99)	$F(2, 2150) = 41.77$, $p < 0.001$
9	Dedication	−1.02 (3.87)	−0.57 (2.52)	−0.56 (2.45)	16.54 (3.72)	15.05 (4.42)	14.95 (4.17)	$F(2, 2150) = 34.79$, $p < 0.001$
10	Absorption	−0.37 (2.57)	−0.48 (2.46)	−0.53 (2.54)	13.86 (4.19)	14.06 (4.51)	13.88 (4.23)	$F(2, 2150) = 0.46$, $p = 0.631$

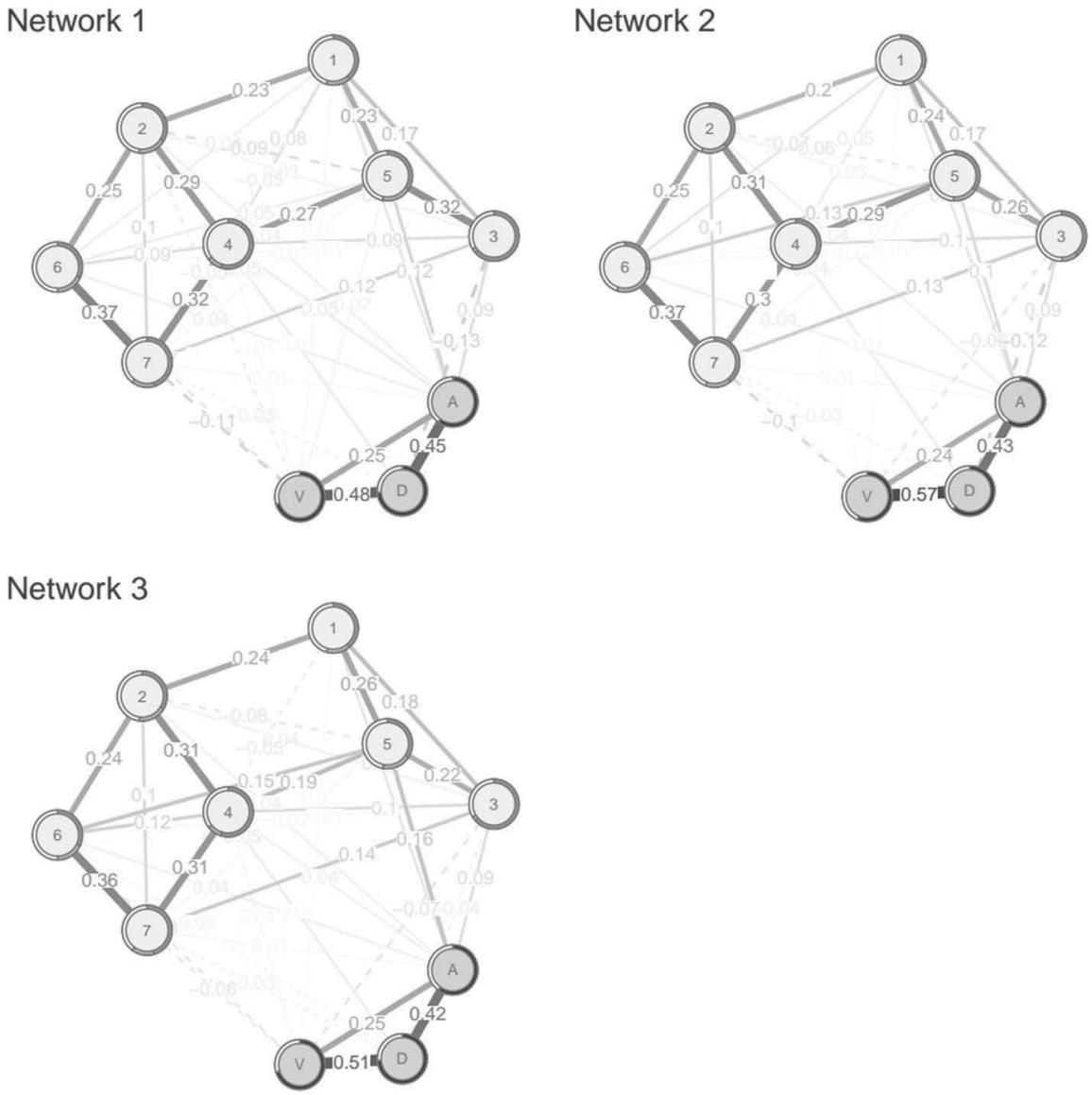

Fig. 1 The three regularized partial correlation networks estimated jointly for the three samples. The lighter gray nodes represent the symptoms of work addiction, and the darker gray nodes represent the dimensions of work engagement. Solid lines represent positive edges, and dashed lines represent negative edges. Line thickness and darkness indicate the strength of a relationship. In the case of symptoms of work addiction, the lighter gray area in the ring around a node represents predictability based on the variance of a symptom explained by all of its neighbors, and the darker gray area in the ring around a node represent predictability based on the marginal distribution of a node. In the case of dimensions of work engagement, the black area in the ring around a node represents a proportion of explained variance (R^2). 1, salience; 2, tolerance; 3, mood modification; 4, relapse; 5, withdrawal; 6, conflict; 7, problems; V, vigor; D, dedication; A, absorption

Network Stability

Stability analyses showed that all three networks were accurately estimated, with small to moderate confidence intervals around the edge weights. The correlation stability coefficients exceeded the minimal threshold of 0.25 for stable estimation of centrality indices (Epskamp et al., 2018) for network 2 (0.44) and did not exceed this threshold for network 1 (0.21) and network 3 (0.13). Consequently, we focused on a detailed interpretation of the standard version of the node strength only in network 2.

Network Inference

In the case of network 2, dedication (D) was the most central node (unstandardized value equaled 1.20), and salience (1) was the least central node (unstandardized value equaled 0.80). However, the standard version of the node strength poorly differentiated node centrality in the three networks (see panel A on Fig. 2). Spearman correlation coefficients of the standard version of the node strength equaled 0.82 for network 1 and network 2, 0.88 for network 1 and network 3, and 0.62 for network 2 and network 3.

The bridge strength showed that mood modification (3) was the most central symptom of work addiction (unstandardized value equaled 0.22 for network 1, 0.27 for network 2, and 0.20 for network 3) and that absorption (A) was the most central dimension of work engagement (unstandardized value equaled 0.42 for network 1, 0.35 for network 2, and 0.45 for network 3; see panel B on Fig. 2). Spearman correlation coefficients of the bridge strength equaled 0.95 for network 1 and network 2, 0.89 for network 1 and network 3, and 0.87 for network 2 and network 3.

Predictability analysis showed that conflict (6) was the most predictable symptom of work addiction (average predictability equaled 22.7%) and that mood modification (3) was the least predictable symptom of work addiction (average predictability equaled 8.4%; see Fig. 1). The three dimensions of work engagement showed a similarly high level of predictability, and dedication (D) was the most predictable one (average predictability equaled 66.2%). Average predictability equaled 36.9% in network 1, 37.1% in network 2, and 38.6% in network 3.

Network Comparison

Spearman correlation coefficients of edge weights equaled 0.95 for network 1 and network 2, 0.95 for network 1 and network 3, and 0.94 for network 2 and network 3. In the omnibus tests of the three possible pairwise comparisons, network 1 differed significantly from network 2 ($p = 0.032$), network 1 differed significantly from network 3 ($p = 0.042$),

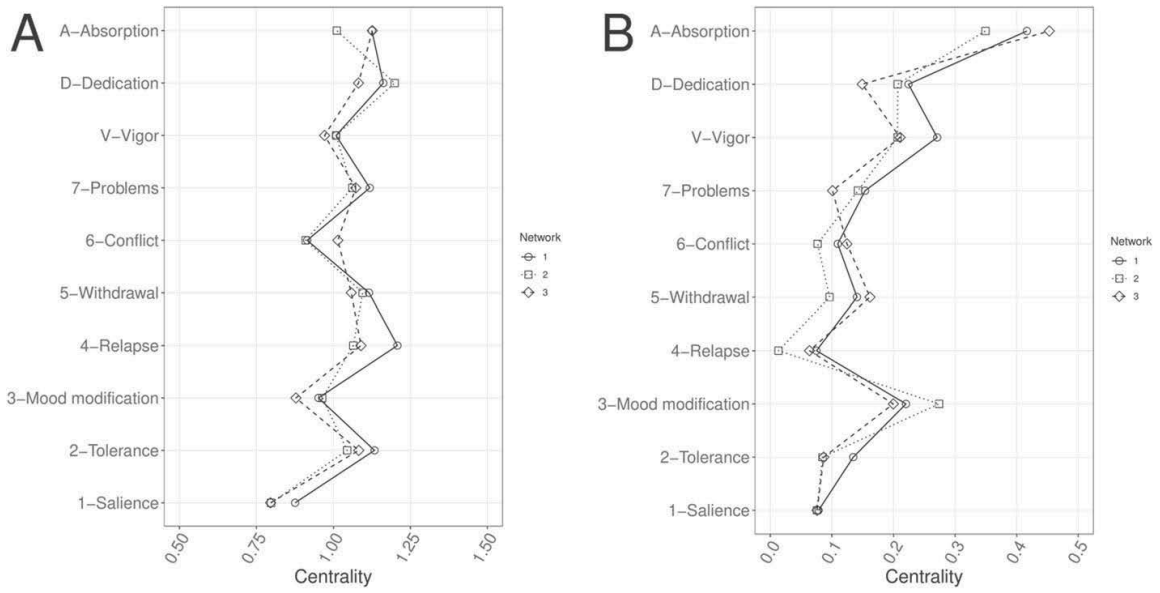

Fig. 2 **A** The unstandardized values of the standard version of the node strength in the three networks. **B** The unstandardized values of the bridge strength in the three networks

and network 2 did not differ significantly from network 3 ($p = 0.124$). The comparison of network 1 and network 2 revealed that of all 45 edges, seven edges (15.6%) differed significantly: relapse (4)—withdrawal (5), salience (1)—conflict (6), relapse (4)—conflict (6), problems (7)—vigor (V), tolerance (2)—dedication (D), vigor (V)—dedication (V), and withdrawal (5)—absorption (A). The comparison of network 1 and network 3 revealed that of all 45 edges, three edges (6.7%) differed significantly: mood modification (3)—withdrawal (5), withdrawal (5)—conflict (6), and vigor (V)—dedication (D). Global strength did not differ significantly ($p > 0.05$) between the three networks, and its values were 4.61, 4.58, and 4.66 for network 1, network 2, and network 3, respectively.

Figure 3 depicts the cross-sample network with averaged edge weights (panel A), the cross-sample variability network (panel B), the unstandardized values of the standard version of the node strength in the cross-sample network (panel C), and the unstandardized values of the bridge strength in the cross-sample network (panel D). The strongest edges connecting the seven symptoms of work addiction and the three dimensions of work engagement were withdrawal (5)—absorption (A), mood modification (3)—absorption (A), and mood modification (3)—dedication (D) with edge weights of 0.10, 0.10, and −0.10, respectively. The most variable edges connecting the seven symptoms of work addiction and the three dimensions of work engagement were problems (7)—vigor (V), mood modification (3)—dedication (D), and withdrawal (5)—absorption (A), with standard deviations of 0.06, 0.05, and 0.05, respectively.

The correlation stability coefficient of the cross-sample network was equal to 0.52 and exceeded the recommended threshold of 0.50 for stable estimation of centrality indices (Epskamp et al., 2018). The standard version of the node strength showed that relapse (4) was the most central symptom of work addiction (unstandardized value equaled 1.03), salience (1) was the least central symptom of work addiction (unstandardized value equaled 0.75), and dedication (D) was the most central dimension of work engagement (unstandardized value equaled 1.11). The bridge strength showed that mood modification (3) was the most central symptom of work addiction (unstandardized value equaled 0.26), relapse (4) was the least central symptom of work addiction (unstandardized value equaled 0.00), and absorption (A) was the most central dimension of work engagement (unstandardized value equaled 0.39).

Discussion

This study aimed to investigate direct relationships of work addiction symptoms with work engagement dimensions in the three samples with diverse cultural and sociodemographic backgrounds. For this purpose, we jointly estimated the three networks from the three samples and combined the three samples into one to estimate the cross-sample network; the edges estimated in those networks were stable. There were a few differences in edge weights between the networks (two related to edges between work engagement dimensions and work addiction symptoms). The dissimilarities occurred between Polish and Norwegian networks, whereas there were none between the two Polish networks. They might indicate some cultural differences in the mechanisms of work engagement and its relationship to work addiction in Poland and Norway (see Schaufeli (2017)). Still, we see no consistent pattern of those differences, and the presented results do not allow us to draw any sensible conclusions on the nature of those differences.

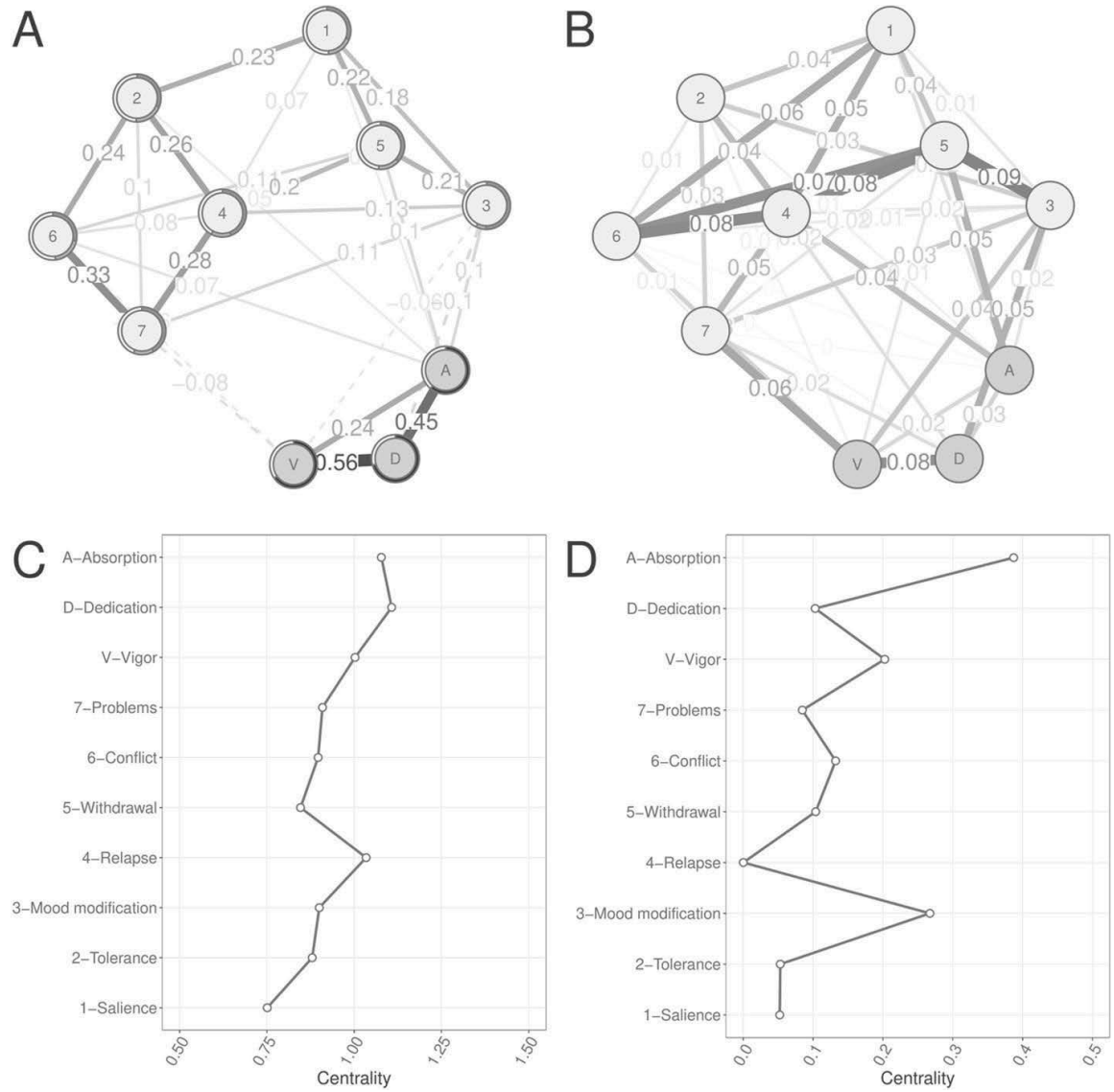

Fig. 3 **A** The cross-sample network, which was obtained by pooling all observations into one sample, and **B** the cross-sample variability network in which edge weights represent the standard deviation of edge weights between the three jointly estimated networks. The lighter gray nodes represent the symptoms of work addiction, and the darker gray nodes represent the dimensions of work engagement. Solid lines represent positive edges, and dashed lines represent negative edges. Line thickness and darkness indicate the strength of a relationship. In the case of symptoms of work addiction on panel A, the lighter gray area in the ring around a node represents predictability based on the variance of a symptom explained by all of its neighbors, and the darker gray area in the ring around a node represents predictability based on the marginal distribution of a node. In the case of dimensions of work engagement on panel A, the black area in the ring around a node represents a proportion of explained variance (R^2). **C** The unstandardized values of the standard version of the node strength in the cross-sample network. **D** The unstandardized values of the bridge strength in the cross-sample network

In the estimated networks, we observed three distinct clusters of nodes; one cluster for the dimensions of work engagement and two clusters for the work addiction symptoms (hypothesis 1 substantiated). The work engagement cluster was connected to the work addiction clusters through the negative edges between vigor (V) and mood modification (3), conflict (6), and problems (7) and positive edges between absorption (A) and all the addiction symptoms (however, absorption [A] formed the most stable relationships with salience [1], tolerance [2], mood modification [3], withdrawal [5], and conflict

[6]). Moreover, the work engagement cluster was connected to the work addiction clusters through the positive edge between dedication (D) and tolerance (2) and the negative edge between dedication (D) and mood modification (3; see Figs. 1 and 3; hypothesis 2 partially substantiated). These results indicate that lower energy (vigor) in work co-occurs with a tendency to improve one's mood through work, work-related internal and external conflicts, and work-related problems. Moreover, higher work absorption co-occurs with experiencing all addiction symptoms, and higher work dedication co-occurs with staying longer hours at work and less frequent mood modifying through work. The engagement cluster showed stronger connection with the cluster including salience, mood modification, and withdrawal than with the cluster including tolerance, relapse, conflict, and problems. This disproportion in number and strength of the edges between the two pairs of clusters provides additional supports for the assumption that the two clusters represent groups of more and less pathological symptoms of work addiction (Bereznowski et al., 2021; see also Charlton & Danforth, 2007).

The observed number of the edges connecting the work engagement cluster with the work addiction clusters substantially surpassed the number we expected and hypothesized. Nevertheless, all of the edges were weak (in most cases, their absolute values were smaller than or equal to 0.10), which is consistent with previous studies of the relationship between work addiction and work engagement (Clark et al., 2016; Di Stefano & Gaudiino, 2019). The unexpected edges could indicate that the presence of symptoms of work addiction deteriorates work engagement of working individuals (e.g., an individual who uses work for mood modification becomes less dedicated and has less energy to work overtime), which would be compatible with the network theory of mental disorders (Borsboom, 2017).

The correlation stability coefficient indicated that the standard version of the node strength was not stable in two of the three jointly estimated networks. For this reason, we have established the bridge strength, which includes only the edges between the engagement and addiction clusters. We reckon that this solution may be better when the bridges do not result from overlapping symptoms (e.g., as in the case of depression and anxiety; see Borsboom and Cramer (2013)). Based on the bridge strength, we found that absorption (A) had the strongest and direct connections with addiction symptoms and mood modification (3) had the strongest and direct relations with the dimension of work engagement (see Fig. 2; hypothesis 3 substantiated). These results suggest that highly engaged employees can develop addiction through excessive absorption with work when they neglect other spheres of life. Mood modification could be the first symptom that prognoses future work addiction development. It is consistent with the theory of addiction that conceptualizes the disorder as a maladaptive form of modifying one's mood (Shaffer et al. (2004); see also Jacobs (1986)). However, the sole positive influence of working on one's emotional state must not be necessarily equal to being addicted (Griffiths et al., 2018).

Moreover, it has to be acknowledged that work may improve mood in numerous non-pathological ways. Like other substances and behaviors, it can be a potent but safe mood enhancer when used in moderation. It is strictly related to the ability of work to give rush and "high" (see Robinson (2014)). This experience is also a definitional part of the absorption component of engagement. However, when it starts to be used habitually and gets out of control, addiction may develop. According to our results, the highly engaged employees might use excessive work to cope with various difficulties and escape negative emotions. On the other hand, connections between absorption and addiction symptoms could be attributed to content validity issues of the work addiction items (Bereznowski et al. (2021), Bereznowski and Konarski (2020); see also Kulikowski (2019)). Some of work addiction

items may not capture the clinical addictive aspect of excessive work involvement fully. In that case, apart from work addiction, those items can also measure engagement and, specifically, absorption. However, separating "high" and flow characterized by absorption present in healthy engagement and addiction may be psychometrically very complex. By analogy, many effects of alcohol intoxication are indistinguishable in individuals addicted to alcohol and non-problematic alcohol consumers, e.g., decreased fear or tension. Consequently, more studies examining the validity of both addiction and engagement are needed to understand this issue fully. Perhaps, the only way to control the shared components of absorption in engagement and addiction in practice is through analytical and statistical procedures (Atroszko & Atroszko, 2019).

In general, the predictability in all three networks was comparable. The most predictable node for the addiction cluster was conflict (6), while the least predictable was mood modification (3). The predictability was similar for all the dimensions in work engagement, but dedication (D) was the most predictable. These results imply that among work addiction symptoms, internal and external conflicts related to addiction might be the most easily diminished through interventions aimed at different symptoms of work addiction and dimensions of work engagement. However, the inclusion of the dimensions of work engagement in the networks only slightly increased the predictability of work addiction symptoms in comparison to networks including only the symptoms (Bereznowski et al., 2021), which indicates that the development of work addiction purely based on high work engagement is unlikely. Moreover, these results imply that work engagement dimensions strongly predict each other. Work engagement might be a system that is easier to change as a whole rather than through several localized interventions focused at a single dimension or that work engagement is better conceptualized in the latent trait framework than in the network framework (Golino & Epskamp, 2017; see also Kulikowski, 2019).

Strengths and Limitations

The investigation was performed in three large samples that differed in terms of nationality and sociodemographic background. The networks were estimated using joint network estimation and compared quantitatively. Work addiction and work engagement were measured with the same instrument (i.e., the BWAS and the UWES) in each sample. The dimensions of work engagement were measured with three items each, which should reduce bias related to the unreliability of single-item indicators. The three networks estimated in this study included the external field of work addiction symptoms (i.e., the dimensions of work engagement; Borsboom, 2017), which addresses the issue of rare investigation of external fields of mental disorders in psychological networks (Fried, 2020). As a result, this study contributes not only to the literature on compulsive overworking and behavioral addictions but also to the still scant literature on the replicability of psychological networks (Borsboom et al., 2017; Forbes et al., 2017a, b) and literature on the external fields of mental disorders.

In terms of limitations, the three samples were predominantly female. They represented general populations from just two European countries, which puts restrictions on the generalizability of the results to clinical populations and populations from other countries and cultures. The data were cross-sectional, which puts limitations on causal inference. The symptoms of work addiction were measured with single items, which may bias estimates of network parameters. The estimated networks might include a few spurious edges connecting the engagement cluster and the addiction clusters as the power of jointly estimated

networks has not been thoroughly studied yet. Last but not least, this study did not account for the effects of other mental disorders and psychological constructs (e.g., occupational stress and job burnout; Clark et al., 2016), which may influence the direct relationships between work addiction symptoms and work engagement dimensions.

Conclusions and Future Study Directions

This study showed that absorption is directly positively related to all symptoms of work addiction; vigor is directly negatively related to mood modification, conflict, and problems; and dedication is directly positively related to tolerance and directly negatively related to mood modification. There were two most important results related to the relationship between work addiction and work engagement. First, absorption showed multiple direct relationships with work addiction symptoms. Second, mood modification showed multiple direct relationships with work engagement dimensions. These results suggest that further investigation of properties of absorption and mood modification might be crucial for answering the question of how engaged workers become addicted to work. At the same time, the results show that network analysis might be a useful analytical technique for untangling some complicated relationships between psychological phenomena.

Future studies should investigate networks including additional variables in the external field of the work addiction symptoms such as job burnout, occupational stress, perfectionism, or work-life conflict (see Clark et al. (2016)). Cross-validation of the investigated networks with different item wordings would increase the generalizability of the results and perhaps improve the validity of networks. Also, studies based on clinical samples and epidemiological surveys, including other psychopathologies and studies investigating potential sex differences in networks, are highly warranted. These should include replication of the current study on study addiction conceptualized as an early form of work addiction (Atroszko et al., 2015, 2016) and intensive longitudinal designs, which would allow investigating the assumption that cross-sectional data is a good representation of a dynamic process of work addiction within individuals. Moreover, future studies should investigate the direction of the relationships between work addiction symptoms and work engagement dimensions using structural equation modeling. Last but not least, future studies should investigate the properties of the bridge strength index introduced in this study.

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Author Contribution PB assisted with obtaining funding, literature search, study design and concept, statistical analyses, data interpretation, generation of the initial draft of the manuscript, manuscript preparation and editing, and final editing; AB assisted with literature search, data interpretation, generation of the initial draft of the manuscript, manuscript preparation and editing, and final editing; PAA assisted with literature search, study design and concept, data collection, data interpretation, manuscript preparation and editing, and final editing; RK assisted with study design and concept, manuscript preparation and editing, and final editing.

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Declarations

Ethics The study was carried out in accordance with the Declaration of Helsinki. All gathered data was anonymous, and participants were informed about all the proper details about the study and their role in it, including that they can withdraw at any point. Attaining formal and written informed consent was not regarded as necessary as voluntary completion of the questionnaires was regarded as providing consent, and no medical information was gathered.

Conflict of Interest The authors declare no competing interests.

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Work addiction, work engagement, job burnout, and perceived stress: A network analysis

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Introduction: Recently, the network theory of mental disorders has been used to conceptualize work addiction as a dynamic system of symptoms in direct relationships. This study aimed to extend previous work by investigating the direct relationships of work addiction symptoms with dimensions of work engagement, job burnout, and perceived stress.

Methods: These phenomena were measured with the Bergen Work Addiction Scale, the Utrecht Work Engagement Scale, the Maslach Burnout Inventory–General Survey, and the Perceived Stress Scale. The sample comprised 676 working Poles with a mean age of 36.12 years (SD = 11.23). The network analysis followed the guidelines for estimating psychological networks from cross-sectional data.

Results: Work engagement and job burnout were more closely associated with each other than with work addiction which supports the notion that engagement and burnout represent polar opposites of the same construct and that work addiction is a separate phenomenon, related to both work engagement and job burnout *via* specific pathways. The symptoms of work addiction were connected with other phenomena through four direct relationships: (1) mood modification—absorption, (2) mood modification—stress, (3) withdrawal—absorption, and (4) problems—exhaustion.

Discussion: These findings narrow down and specify hypotheses regarding potential mechanisms leading from engagement to addiction and from addiction to burnout. The possible mechanisms focus on the absorption component and mood modification related to efforts focused on alleviating chronic stress and negative emotional states. In turn, problems arising from work addiction may lead to exhaustion. Future studies investigating these mechanisms in detail may enable proper prevention programs and therapeutic interventions.

KEYWORDS

network analysis, job burnout, perceived stress, work addiction, work engagement, workaholism, network approach

1. Introduction

Over 745 thousand deaths worldwide could be attributed to overworking every year, and it only accounts for cardiovascular-related problems attributed to workload (Pega et al., 2021). A substantial portion of these deaths could be arguably attributed to compulsive overworking, which is strictly related to excessively high workload. Compulsive overworking has a prevalence rate from 8.3 to 20.6% in nationally representative samples of working populations, depending on the country (for an overview of prevalence data, see Atroszko, 2022a) and is gradually recognized as a major epidemiological concern globally (compulsive overworking is often referred to as work addiction or workaholism; Griffiths et al., 2018; Balducci et al., 2020; Atroszko, 2022a,b). Meta-analyses and reviews suggest that compulsive overworking could lead to occupational stress, deteriorated work engagement, job burnout, and eventually, a global burden of disease (Patel, 2011; Clark et al., 2016; Di Stefano and Gaudiino, 2019; Atroszko et al., 2020a). In this study, we aimed to investigate the direct relationships of work addiction symptoms to dimensions of work engagement, job burnout, and perceived stress.

Several conceptualizations of compulsive overworking are present in the literature (e.g., Schaufeli et al., 2009; Vallerand et al., 2010; Snir and Harpaz, 2012; Loscalzo and Giannini, 2018; Atroszko et al., 2019; Clark et al., 2020), including the one using a behavioral addictions framework and labeling this phenomenon "work addiction" (for an overview, see Atroszko, 2022a,b). Work addiction has been defined as "a compulsion to work and preoccupation with work activities leading to a significant harm and distress of a functionally impairing nature to the individual and/or other significantly relevant relationships (friends and family). The behavior is characterized by the loss of control over the working activity and persists over a significant period of time. This problematic work-related behavior can have varying intensity from mild to severe" (Atroszko et al., 2019, p. 9). The work addiction conceptualization often refers to the common addiction components model, which includes seven addiction symptoms (Brown, 1993; Griffiths, 2005): (1) *salience* (work dominates thoughts, feelings, and behavior), (2) *tolerance* (increasing amounts of work are needed to achieve former mood modification effects), (3) *mood modification* (work leads to feelings of "high" or "escape"), (4) *relapse* (repeated revisions to a pattern of excessive work), (5) *withdrawal* (being unable to work leads to unpleasant feelings and/or states), (6) *conflict* (with other activities, needs, and people), (7) *problems* (health and/or other problems resulting for excessive work; Griffiths, 2011; Andreassen et al., 2012).

Recently, the network theory of mental disorders (Borsboom, 2017) has been used to conceptualize work addiction as a network of symptoms in direct relationships (Bereznowski et al., 2021, 2022). A network is a graph composed of nodes representing observed variables (e.g., a symptom of work addiction or a dimension of job burnout) and edges representing the estimated strength of direct relationships between the observed variables. Positive edges are usually depicted as solid blue lines and indicate that higher (lower) levels of node A co-occur with higher (lower) levels of node B when levels of other nodes in a network remain constant. Negative edges are usually depicted as solid red lines and indicate that higher (lower) levels of node A co-occur with lower (higher) levels of node B when levels of other nodes in a network remain constant. The magnitude of similarity of the levels of the two nodes depends on the strength of the relationships between a pair of nodes. A process of analyzing a pattern of the estimated edge weights, using specially designed statistical methods, is called network analysis (Epskamp et al., 2018). The results of network analysis could provide valuable insights regarding potential targets of therapeutic interventions and prevention programs (the target could be either a node or an edge between nodes; Cramer et al., 2016; Borsboom, 2017).

So far, there have been two studies using the network theory framework to investigate direct relationships of symptoms of work addiction (Bereznowski et al., 2021; Bereznowski et al., 2022; both studies used the same samples (four and three samples, respectively) and one of these samples was used in the present study as well). Bereznowski et al. (2022) investigated the simplest possible network which included only the symptoms of work addiction. The results showed that the symptoms of work addiction formed two clusters. The first cluster included silence, mood modification, and withdrawal. The second cluster included tolerance, relapse, conflict, and problems. These clusters showed partial overlap with a distinction between peripheral (cognitive salience, tolerance, and euphoria) and core (conflict, withdrawal symptoms, relapse and reinstatement, and behavioral salience) symptoms of gaming addiction (Charlton and Danforth, 2007). Based on these results, Bereznowski et al. (2021) argued that the inclusion of other work-related phenomena might help validate the claim that the two clusters represent more and less pathological groups of work addiction symptoms.

Bereznowski et al. (2021) investigated the relationships between symptoms of work addiction and dimensions of work engagement. Work engagement is a positive work-related mental state. According to the most popular conceptualization (Schaufeli et al., 2002), it is characterized by (1) *vigor* ("high levels of energy and mental resilience while working, the willingness to invest effort in one's work, and persistence even in the face of difficulties"; Schaufeli et al., 2002, p. 74), (2) *dedication* ("experiencing a sense of significance, enthusiasm, inspiration, pride, and challenge"; Schaufeli et al., 2002, p. 74), and (3) *absorption* ("being fully concentrated and deeply engrossed in one's work, whereby time passes quickly and one has difficulties with detaching oneself from work"; Schaufeli et al., 2002, p. 75). As work engagement is a positive phenomenon, it was expected that the three dimensions of work engagement should have stronger positive relationships with less pathological than with more pathological symptoms of work addiction. The results showed that dimensions of work engagement formed an independent cluster which was mainly connected with symptoms of work addiction through positive relationships with the absorption component (the strongest relationships were observed with mood modification and withdrawal). However, there were also negative connections between vigor and mood modification, conflict, and problems, and between dedication and mood modification which could indicate negative consequences of work addiction on work engagement (Bereznowski et al., 2021), which might be mediated by job burnout (work addiction leads to job burnout which in turn deteriorates work engagement).

The purpose of this study was to extend the previous work of Bereznowski et al. (2021, 2022) by including in the network two

negative phenomena: job burnout (a possible mediator between work addiction and work engagement) and perceived stress (one of the most important causes of work addiction). In the 11th Revision of the International Classification of Diseases (ICD-11; World Health Organization, 2019), job burnout has been classified as an occupational phenomenon (a reason for which people contact health services other than illness). Job burnout has been defined as a result of chronic workplace stress that has not been successfully managed, which is characterized by (1) *exhaustion* (feelings of energy depletion), (2) *cynicism* (increased mental distance from one's work and negativism related to one's work), and (3) *professional efficacy* (a sense of ineffectiveness and lack of accomplishment; World Health Organization, 2019). Perceived stress has been defined as "the feelings or thoughts that an individual has about how much stress they are under at a given point in time or over a given time period" (Phillips, 2013, p. 1453). When investigating the extended network of work addiction, we focused on the following research questions. Do job burnout and perceived stress form independent clusters in the network? Does the inclusion of job burnout and perceived stress in the network influence direct relationships between symptoms of work addiction and dimensions of work engagement? Which symptoms of work addiction are directly related to perceived stress? Which symptoms of work addiction are directly related to which dimensions of job burnout?

Previous research grounded in the network framework showed that work addiction symptoms form two clusters possibly representing core and peripheral symptoms of addiction and that dimensions of work engagement form the third independent cluster (Charlton and Danforth, 2007; Bereznowski et al., 2021, 2022). Based on the previous research, it seems reasonable to assume that the dimensions of job burnout form another independent cluster in the network. Consequently, we expect that work addiction symptoms, work engagement dimensions, and job burnout dimensions will form four clusters in the estimated network: (1) more pathological (i.e., core) work addiction symptoms (tolerance, relapse, conflict, and problems), (2) less pathological (i.e., peripheral) work addiction symptoms (salience, mood modification, and withdrawal), (3) work engagement dimensions, and (4) job burnout dimensions. After considering the crucial role of perceived stress in both work addiction and job burnout, particularly its exhaustion component (Bianchi and Schonfeld, 2018; Griffiths et al., 2018; World Health Organization, 2019), we expect stress to be directly related to relevant components of work addiction and job burnout.

A study by Bereznowski et al. (2021) grounded in the network framework, showed that each work engagement dimension had direct relationships with at least two symptoms of work addiction. However, most of these relationships were very weak. Meta-analyses grounded in the latent trait framework showed that work addiction was associated with a single dimension of work engagement (i.e., absorption; Clark et al., 2016; Di Stefano and Gaudiino, 2019). Based on these premises, we predict that after controlling for the effects of job burnout dimensions and perceived stress, it is likely that the only statistically significant relationships between work addiction symptoms and work engagement dimensions will be the relationships including absorption.

Previous meta-analyses showed that work addiction was associated with stress and other stress-related psychological phenomena such as job demands, work-life balance, or work-family conflict (Patel, 2011; Clark et al., 2016; Atroszko, 2022a,b). Based on the definitions of the symptoms of work addiction, only four out of seven work addiction symptoms should be related to perceived stress. Two symptoms might be related directly (i.e., mood modification and withdrawal), and two indirectly (conflict and problems). Based on these premises, we predict that only mood modification and withdrawal will have direct relationships with perceived stress.

Finally, a meta-analysis conducted by Clark et al. (2016) showed that work addiction was associated with all dimensions of job burnout. However, some work addiction symptoms might be more pathological (tolerance, relapse, conflict, and problems) than others (salience, mood modification, and withdrawal; Bereznowski and Konarski, 2020; Bereznowski et al., 2021; see also Charlton and Danforth, 2007). Consequently, we predict that only these more pathological symptoms (i.e., tolerance, relapse, conflict, and problems) will have direct relationships with the dimensions of job burnout.

Based on previous empirical research and theoretical considerations, we formulated the following hypotheses. Hypothesis 1: The network including work addiction, work engagement, job burnout, and perceived stress will have four clusters of nodes (cluster 1: tolerance, relapse, conflict, and problems; cluster 2: salience, mood modification, and withdrawal; cluster 3: work engagement dimensions; cluster 4: job burnout dimensions). Hypothesis 2: Work addiction symptoms will have direct relationships only with one dimension of work engagement (i.e., absorption). Hypothesis 3: Only mood modification and withdrawal will have direct relationships with perceived stress. Hypothesis 4: Only tolerance, relapse, conflict, and problems will have direct relationships with job burnout dimensions. For a visual representation of the hypotheses see **Figure 1**. Please note that **Figure 1** presents the hypotheses in a generic form and that it is not required to observe all the edges presented in **Figure 1** to confirm hypotheses 2 and 4.

2. Materials and methods

2.1. Study design

Data collection was based on convenience sampling of working professionals in Poland and took place from January 2014 to July 2016 (this sample was gathered during the research with a focus on work addiction; Atroszko et al., 2017). The study was a pen-and-pencil cross-sectional study. Working individuals from a wide range of professions (e.g., managers, lawyers, academics, medical doctors, teachers, engineers, accountants, IT specialists, and functionaries) were invited directly or through their employers to participate in the study. The participants filled in the questionnaire in an individual setting during their working hours (a few employers decided to gather the willing employees in a conference room for the time of filling in the questionnaire). Participation in the study was completely anonymous, and no monetary or other material rewards were offered.

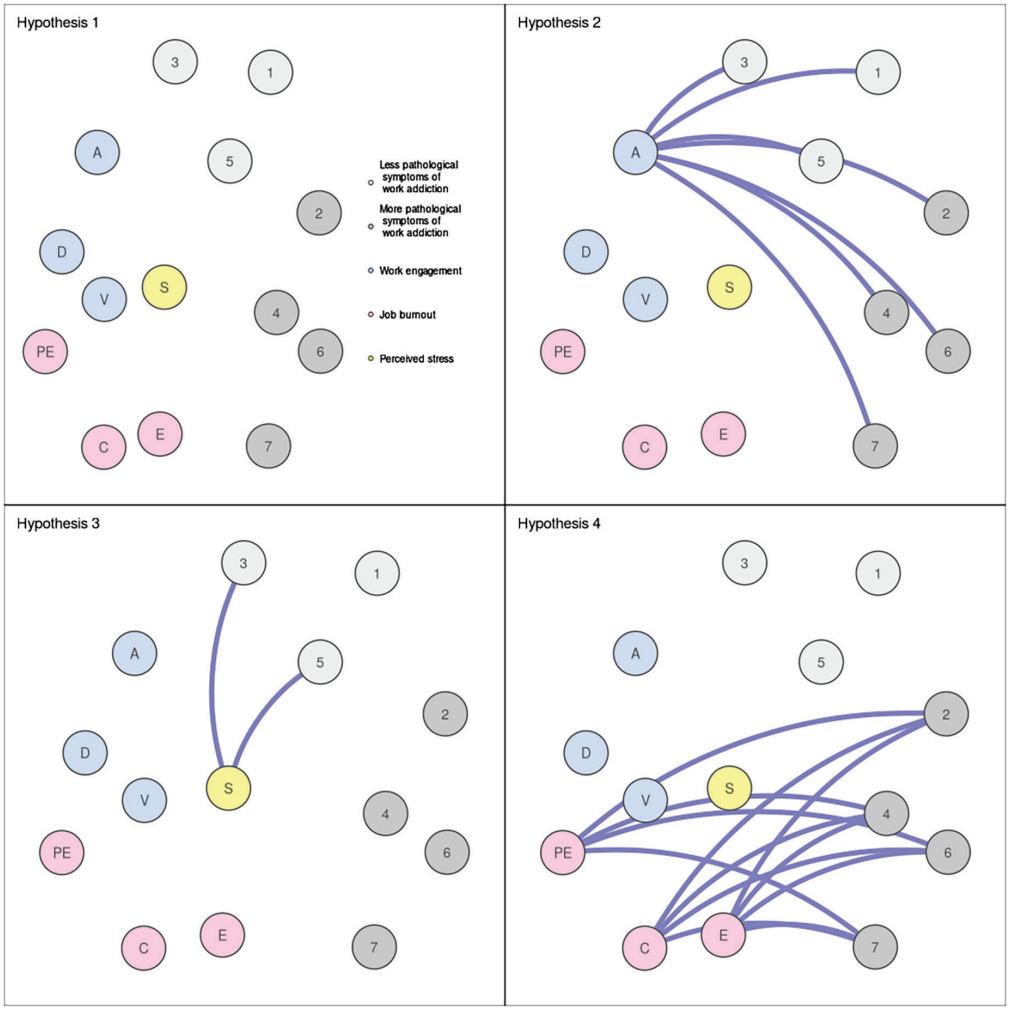

FIGURE 1
The visual representation of this study's hypotheses in a generic form. The panel for hypothesis 1 presents the hypothesized clusters of symptoms. The panels for hypotheses 2, 3, and 4 present the hypothesized direct relationships between work addiction symptoms and dimensions of other phenomena in the network. 1 = salience; 2 = tolerance; 3 = mood modification; 4 = relapse; 5 = withdrawal; 6 = conflict; 7 = problems. S, perceived stress; E, exhaustion; C, cynicism; PE, professional efficacy; V, vigor; D, dedication; A, absorption.

2.2. Ethics

The study was reviewed and approved by the Norwegian Data Protection Official for Research and the Research Ethics Committee at the Institute of Psychology of the University of Gdańsk in Poland. Written informed consent was obtained from each participant before the completion of the questionnaire.

2.3. Participants

Initially, the sample included responses from 723 working Poles. After listwise deletion, the sample included 676 individuals. Their mean age was 36.12 years (SD = 11.23), ranging from 20 to 79. Detailed sociodemographic characteristics of the sample after listwise deletion of observations with missing data on work addiction, work engagement, job burnout, and perceived stress are presented in Table 1.

2.4. Measures

Participants were asked about their basic demographic information (sex, age, marital status, and years of education) and basic information about their work [level of managerial position, working hours per week, work status, and an open-ended question about their last year's income (i.e., past year's personal annual income before tax)].

2.4.1. Work addiction

The Bergen Work Addiction Scale (BWAS; Andreassen et al., 2012) consists of seven items based on the seven symptoms of addiction (e.g., "How often during the last year have you thought of how you could free up more time to work?"; Brown, 1993; Leshner, 1997; Griffiths, 2005). Each item asks respondents how often they experienced a given symptom during the past 12 months. The responses are provided on a 5-point Likert scale ranging from 1 (*never*) through 2 (*rarely*), 3 (*sometimes*), 4 (*often*) to 5 (*always*). This measure does not have a skip-structure, and we did not

preprocess the obtained responses in any way. The Polish version of the BWAS showed good content, convergent, criterion, and factor validity in previous studies (Atroszko et al., 2017). In this study, the Cronbach's alpha reliability coefficient was 0.84.

2.4.2. Work engagement

The 9-item version of the Utrecht Work Engagement Scale (UWES-9; Schaufeli et al., 2006) consists of three items for each dimension of work engagement: vigor (e.g., "At my work, I feel bursting with energy."), dedication (e.g., "I am enthusiastic about my job."), and absorption (e.g., "I am immersed in my work."). Each item asks respondents how often they experienced a described state during their lifetime. The responses are provided on a 7-point Likert scale ranging from 1 (*never*) through 2 (*a few times a year or less*), 3 (*once a month or less*), 4 (*a few times a month*), 5 (*once a week*), 6 (*a few times a week*) to 7 (*everyday*) and summed up for each dimension. This measure does not have a skip-structure, and we did not preprocess the obtained responses in any other way than obtaining a sum for each dimension. The UWES showed good content, convergent, criterion, and factor validity in previous studies (Schaufeli et al., 2006; for a systematic review of research in Polish context, see Pollak et al., 2017). In this study, the Cronbach's alpha reliability coefficients were 0.85 (vigor), 0.83 (dedication), and 0.79 (absorption).

TABLE 1 Sociodemographic characteristics of the sample.

Variable	*n* (%)/*M* (SD)/range
Sex	
Female	476 (70.4%)
Male	191 (28.3%)
No answer	9 (1.3%)
Age (*M* [SD])	36.12 (11.23)
Age (range)	20–79
Marital status	
In a relationship	529 (78.3%)
Not in a relationship	143 (21.2%)
No answer	4 (0.6%)
Number of children	
0	282 (41.7%)
1	147 (21.7%)
2	147 (21.7%)
3	31 (4.6%)
4 or more	14 (2.1%)
No answer	55 (8.1%)
Years of education (*M* [*SD*])	17.90 (2.86)
Years of education (range)	9–26
Years of education (no answer)	9 (1.3%)
Managerial position	
Non-managerial	424 (62.7%)
Lower managerial	107 (15.8%)
Middle managerial	54 (8.0%)
Higher managerial	39 (5.8%)
No answer	52 (7.7%)
Working hours per week (*M* [SD])	45.64 (11.81)
Working hours per week (range)	4–98
Work status	
Full-time worker	602 (89.1%)
Part-time worker	58 (8.6%)
No answer	16 (2.4%)
Gross income (*M* [SD])[a]	45744.72 (32692.02) PLN
Gross income (range)[a]	0–200000 PLN

[a]Past year's personal annual income before tax in Polish currency (i.e., PLN).

2.4.3. Job burnout

The Maslach Burnout Inventory – General Survey (MBI-GS; Maslach and Jackson, 1981) consists of 16 items, five for exhaustion (e.g., "I feel burned out from my work"), five for cynicism (e.g., "I have become less enthusiastic about my work"), and six for professional efficacy (e.g., "I feel confident that I am effective at getting things done "; higher scores indicate lower levels of job burnout). Each item asks respondents how often they experienced a described state during their lifetime. The responses are provided on a 7-point Likert scale ranging from 1 (*never*) through 2 (*a few times a year or less*), 3 (*once a month or less*), 4 (*a few times a month*), 5 (*once a week*), 6 (*a few times a week*) to 7 (*everyday*) and summed up for each dimension. This measure does not have a skip-structure, and we did not preprocess the obtained responses in any other way than obtaining a sum for each dimension. The MBI-GS showed good content, convergent, criterion, and factor validity in previous studies (e.g., Schutte et al., 2000; for results of research in Polish context, see Chirkowska-Smolak and Kleka, 2011; Golonka et al., 2019). In this study, the Cronbach's alpha reliability coefficients were 0.89 (exhaustion), 0.71 (cynicism), and 0.83 (professional efficacy).

2.4.4. Perceived stress

The 10-item version of the Perceived Stress Scale (PSS-10; Cohen et al., 1983) measures a general dimension of perceived stress. Each item asks respondents how often they experienced a described state during the past month (e.g., "In the last month, how often have you felt nervous and stressed?"). The responses are provided on a 5-point Likert scale ranging from 1 (*never*) through 2 (*almost never*), 3 (*sometimes*), and 4 (*fairly often*) to 5 (*very often*) and summed up for the general dimension of perceived stress. This measure does not have a skip-structure, and we did not preprocess the obtained responses in any other way than obtaining a sum for the general score. The Polish version of the PSS-10 showed good content, convergent, criterion, and factor validity in previous studies (Lee, 2012, for results of research in Polish context, see Juczyński and Ogińska-Bulik, 2009), including good criterion validity of the current version (Atroszko et al., 2020b). In this study, the Cronbach's alpha reliability coefficient was 0.84.

2.5. Statistical analyses

All analyses were carried out with R version 4.0.5 (R Core Team, 2021) and visualized with the qgraph 1.6.9 package

(Epskamp et al., 2012). For reporting the results, we followed the reporting standards for psychological network analyses in the cross-sectional data set by Burger et al. (2022). The analytic code for all analyses performed in this study and the **Supplementary material** are available at https://osf.io/jvqfa/.

2.5.1. Network estimation

We estimated the network using the bootnet 1.4.7 package (Epskamp et al., 2018) and the EBICglasso method with the threshold parameter equal to TRUE. A layout for visualizations was obtained by setting the layout parameter to "spring." To search for clusters of nodes, we used a spin-glass algorithm implemented in the igraph 1.2.6 package (Csardi and Nepusz, 2006).

2.5.2. Network stability

To investigate the stability of the network, we used the bootnet 1.4.7 package (Epskamp et al., 2018), using non-parametric bootstrapping and case bootstrapping based on 1,000 bootstrap samples. As a measure of network stability, we used the correlation stability coefficient, which represents the maximum proportion of cases that can be dropped, such that with 95% probability, the correlation between original centrality measures and centrality of networks based on subsets is 0.70 or higher. A correlation stability coefficient higher than 0.50 is regarded as an indicator of good stability, and a correlation stability coefficient higher than 0.25 is regarded as an indicator of acceptable stability (Epskamp et al., 2018).

2.5.3. Network inference

We estimated node centrality based on node strength. A standard version of the node strength is a metric equal to the sum of absolute values of all edges of a given node to all other nodes. Its lowest possible value is 0.00 (a node is not connected). Its highest possible value is the number of nodes in a network minus one (a node is connected with all nodes in a network with edges of magnitude 1.00). The nodes with the above-average standard version of the node strength can be identified by multiplying the number of nodes in a network minus one and the mean absolute edge weight (e.g., (14-1) $\times$ 0.06 = 0.78). We argue that the standard version of the node strength could poorly identify bridge nodes when tightly connected clusters of nodes are weakly connected with each other. Therefore, we used a modified version of the node strength (Bereznowski et al., 2021). The modified version of the node strength is a metric equal to the sum of absolute values of all edges (1) a node representing dimensions of work engagement, job burnout, and perceived stress has with nodes representing symptoms of work addiction (e.g., the sum of absolute values of edges between absorption and symptoms of work addiction) or (2) a node representing a symptom of work addiction has with nodes representing other phenomena (e.g., the sum of absolute values of edges between mood modification and dimensions of work engagement, job burnout, and perceived stress). Its lowest possible value is 0.00 (a node is not connected). Its highest possible value is the number of nodes representing other phenomena in a network minus one (a node is connected with all nodes representing other phenomena in a network with edges of magnitude 1.00). The importance of a specific node is determined based on a comparison with other nodes from the same group. The modified version of the node strength should better capture bridge nodes in this special case and allow easier identification of important nodes when many edges connecting clusters are present.

To estimate the predictability of nodes, we used the mgm 1.2-11 package (Haslbeck, 2019). For continuous data (dimensions of work engagement, dimensions of job burnout, and perceived stress), node predictability indicates the percentage of variance explained by all of its neighbors ($R2$). For ordinal data (symptoms of work addiction), node predictability indicates how much a node can be predicted by all of its neighbors, beyond what is trivially predicted by the marginal distribution of this node (for a detailed explanation, see Haslbeck and Waldorp, 2018).

3. Results

3.1. Descriptive statistics

Means, standard deviations, skewness, and kurtosis of the seven symptoms of work addiction, the three dimensions of work engagement, the three dimensions of job burnout, and the general score of perceived stress are presented in **Table 2**.

3.2. Network analysis

Stability analysis showed that the network was accurately estimated, with small to moderate confidence intervals around the edge weights. The correlation stability coefficient equaled 0.67 and exceeded the recommended threshold of 0.50 for stability estimation (Epskamp et al., 2018).

The estimated network is visualized in **Figure 2**. The network density equaled 0.30 (27/91 edges), and the mean absolute edge weight equaled 0.06. The spin-glass algorithm showed that there were four clusters in data. The first cluster included Salience (1), mood modification (3), and withdrawal (5). The second cluster included tolerance (2), relapse (4), conflict (6), and problems (7). The third cluster included vigor (V), dedication (D), absorption (A), and professional efficacy (PE). The fourth cluster included exhaustion (E), cynicism (C), and stress (S). There were four direct edges between symptoms of work addiction and other nodes in the network: mood modification (3)—absorption (A), mood modification (3)—stress (S), withdrawal (5)—absorption (A), and problems (7)—exhaustion (E).

The standard version of the node strength (which takes into account all edges in the network) showed that Dedication (D) was the most central node, and that Mood modification (3) was the least central node in the network (see a left panel in **Figure 3**). The modified version of the node strength (which takes into account only the edges with work addiction symptoms) showed, unsurprisingly, that the most central nodes were Mood modification (3) and Absorption (A; see a right panel in **Figure 3**).

The average predictability in the network equaled 42.0%, the average predictability for symptoms of work addiction equaled 29.9%, and the average predictability for other variables in the network equaled 54.1%. The most predictable symptom of work addiction was Conflict (6) whose predictability equaled 30.5%,

and the least predictable symptom of work addiction was Mood modification (3) whose predictability equaled 13.4%.

4. Discussion

In this study, we aimed to investigate the direct relationships of work addiction symptoms with dimensions of work engagement, job burnout, and perceived stress among working Poles from the general population. In the estimated network, we observed four clusters of nodes. The first and second clusters included work addiction symptoms of potentially different levels of pathology. This is not a novel result as the sample used in this study was one of the samples used in previous studies on network approach to work addiction (Bereznowski et al., 2021, 2022). The third cluster included work engagement dimensions and professional efficacy, which is a dimension of job burnout, and the fourth cluster, included the two remaining job burnout dimensions and perceived stress.

While we expected most of these results, the fact that professional efficacy was in a cluster with work engagement dimensions rather than with job burnout dimensions is worth attention. Even more so, taking into account that the only direct relationship between professional efficacy and other dimensions of job burnout is a positive relationship with cynicism, which indicates that more cynical individuals are also more efficient. These results indicate that professional efficacy shares some unique variance with both work engagement dimensions (dedication and vigor) and cynicism. Consequently, they might indicate that both being passionate about one's work as well as being cynical about it could contribute to being more professionally efficient. However, future studies should investigate whether the magnitude of the shared unique variances is sufficient for such an interpretation to be feasible, as this result seems counterintuitive. Moreover, these results support the notion that professional efficacy is not a part of burnout syndrome, which is increasingly emphasized in the literature and supported by most data (Bianchi and Schonfeld, 2018; Bianchi et al., 2019). On the other hand, professional efficacy is a positively framed construct within a negative burnout syndrome, and is measured as such. Therefore, measurement artifacts related to reverse phrasing of items (positive instead of negative inefficacy) in comparison to other burnout components (negative) need to be taken into account (Gnambs et al., 2018).

Also, it is worth noting that burnout and engagement components were closely associated and ostensibly more with each other than with work addiction. Firstly, it provides further support to the notion that engagement and burnout represent polar opposites of the same construct, which is one of the dominant conceptualizations of their relationship (Maslach and Leiter, 2016). Please note that the two negative edges were observed between dedication and cynicism and between vigor and exhaustion. Based on their definitions, it seems intuitive that an individual with a high level of dedication (enthusiasm about one's work) has a low level of cynicism (negative attitude toward work) and an individual with a high level of vigor (high level of energy) has a low level of exhaustion (low level of energy), and vice versa. Secondly, it supports the notion that work addiction is a clearly separate phenomenon, related to both of them *via* specific pathways.

Work addiction symptoms were connected with dimensions of work engagement, job burnout, and perceived stress through four edges. Mood modification was directly related to absorption and perceived stress. Withdrawal was directly related to absorption. Problems symptom was directly related to exhaustion. These results are mostly congruent with our hypotheses (we did not observe the expected direct relationship between withdrawal and stress as well as direct relationships between tolerance, relapse, and conflict and job burnout dimensions). Based on the addiction model and engagement and burnout theories, these results suggest that engagement may turn into addiction when absorption begins to be habitually used for mood modification purposes among chronically stressed individuals experiencing negative emotional states (Maslach and Leiter, 2016; Bailey et al., 2017; Bianchi and Schonfeld, 2018; Atroszko et al., 2020a; Atroszko, 2022a,b). It may

TABLE 2 Skewness, kurtosis, means, and standard deviations of the study variables.

No.	Node	Skewness (kurtosis)	*M* (SD)	Number of items	Possible range
1	Salience	0.13 (2.03)	2.55 (1.13)	1	1–5
2	Tolerance	−0.34 (2.34)	3.19 (1.04)	1	1–5
3	Mood modification	0.57 (2.16)	2.20 (1.19)	1	1–5
4	Relapse	0.43 (2.07)	2.37 (1.21)	1	1–5
5	Withdrawal	0.57 (2.40)	2.25 (1.16)	1	1–5
6	Conflict	0.07 (1.89)	2.67 (1.23)	1	1–5
7	Problems	0.55 (2.15)	2.18 (1.16)	1	1–5
8	Vigor	−0.55 (2.53)	14.32 (4.20)	3	3–21
9	Dedication	−0.57 (2.54)	15.06 (4.42)	3	3–21
10	Absorption	−0.47 (2.46)	14.09 (4.50)	3	3–21
11	Exhaustion	0.72 (2.89)	15.84 (6.91)	5	5–35
12	Cynicism	1.04 (3.81)	14.71 (5.90)	5	5–35
13	Professional efficacy	−0.62 (2.91)	31.32 (6.90)	6	6–42
14	Perceived stress	0.32 (2.97)	26.51 (6.64)	10	10–50

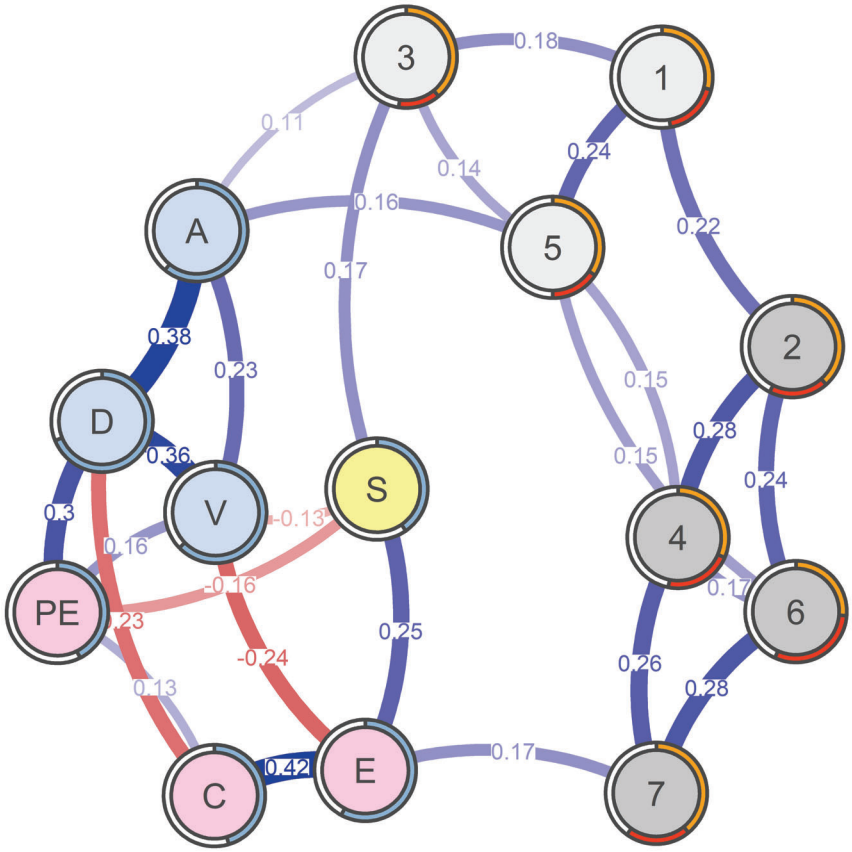

FIGURE 2
The regularized partial correlation network. The lighter gray nodes represent the less pathological symptoms of work addiction, the darker gray nodes represent the more pathological symptoms of work addiction, the yellow node represents perceived stress, the pink nodes represent the dimensions of job burnout, and the blue nodes represent the dimensions of work engagement. Blue lines represent positive edges, and red lines represent negative edges. Line thickness and darkness indicate the strength of a relationship. In the case of symptoms of work addiction, the orange area in the ring around a node represents predictability based on the variance of a symptom explained by all of its neighbors. The red area in the ring around a node represents predictability based on the marginal distribution of a node. In the case of dimensions of work engagement, the blue area in the ring around a node represents a proportion of explained variance (R^2). 1 = salience; 2 = tolerance; 3 = mood modification; 4 = relapse; 5 = withdrawal; 6 = conflict; 7 = problems. S, perceived stress; E, exhaustion; C, cynicism; PE, professional efficacy; V, vigor; D, dedication; A, absorption.

lead to withdrawal symptoms when a person cannot work and become absorbed in work. Absorption is a positive state, sometimes compared to flow, which an individual is experiencing while working (Di Stefano and Gaudiino, 2019). At the same time, an individual absorbed in work might have "difficulties with detaching oneself from work" (Schaufeli et al., 2002, p. 75). It is closely associated with the addictive process and explains the relationship between absorption and withdrawal. In turn, work addiction may lead to burnout by mounting problems leading to exhaustion.

The lack of a direct relationship between withdrawal and perceived stress is surprising. The withdrawal symptom is measured with the question, "How often during the last year have you become stressed if you have been prohibited from working?" (Andreassen et al., 2012, p. 269). Therefore, stress is a central part of this symptom's definition, and it seems justified to expect that there exists a direct relationship between the withdrawal symptom and perceived stress. However, it is also probable that stress resulting from being prohibited from working is only a very small part of stress experienced by people in general. This difference in magnitudes of stress is responsible for the lack of an edge in the estimated network.

The lack of direct relationships between tolerance, relapse, and conflict and dimension of other phenomena is surprising as well. Especially unexpected is the lack of a relationship between tolerance and exhaustion, as spending long hours working could lead to exhaustion. However, as network analysis is focused on direct relationships between nodes, it is possible that the three symptoms are only indirectly related to job burnout dimensions and problems and exhaustion are mediators of these relationships. These findings are particularly important as they narrow down and specify hypotheses regarding potential mechanisms leading from engagement to addiction and addiction to burnout.

4.1. Strengths and limitations

We performed the investigation in a relatively large sample, which resulted in the stability of the estimated network. We used widely used instruments to measure work engagement, job

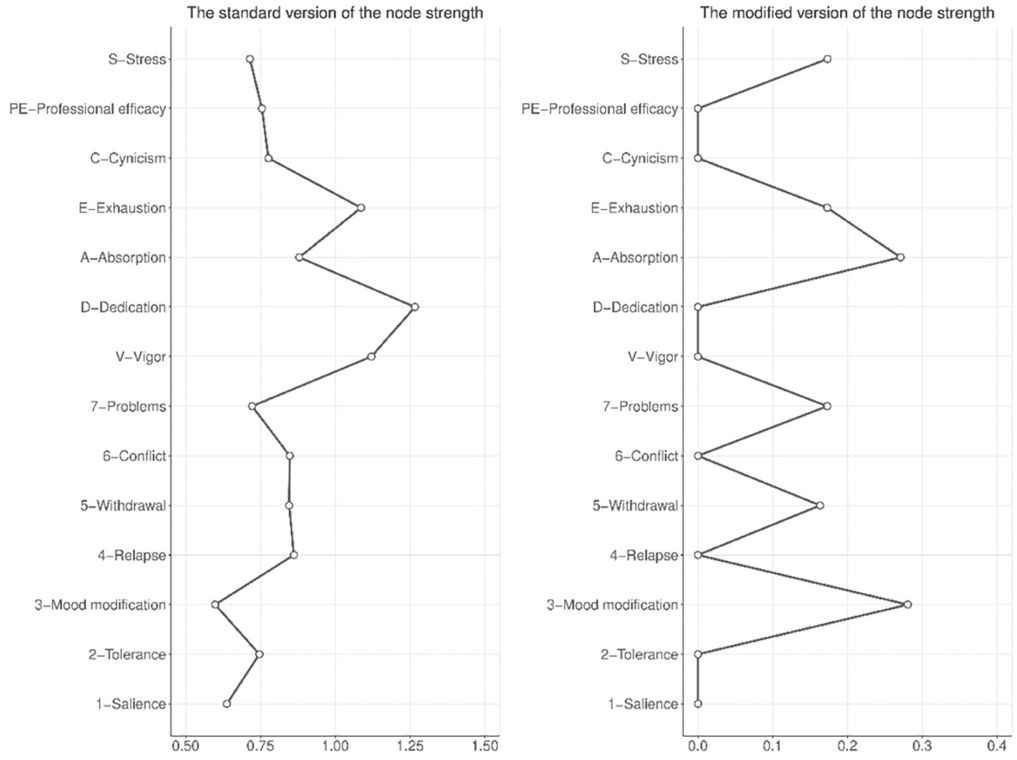

FIGURE 3
The **(left panel)** shows the unstandardized values of the standard version of the node strength in the network. The **(right panel)** shows the unstandardized values of the modified version of the node strength in the network. The modified version of the node strength is a metric equal to the sum of absolute values of all edges (1) a node representing dimensions of work engagement, job burnout, and perceived stress has with nodes representing symptoms of work addiction (e.g., the sum of absolute values of edges between absorption and symptoms of work addiction) or (2) a node representing a symptom of work addiction has with nodes representing other phenomena (e.g., the sum of absolute values of edges between mood modification and dimensions of work engagement, job burnout, and perceived stress).

burnout, and perceived stress. As these instruments use several items per dimension, the bias introduced by the unreliability of dimensions measurement should be reduced. The network estimated in this study included the external field of work addiction symptoms and as such, contributes to the still scant literature on the external fields of mental disorders (Borsboom, 2017; Fried, 2020).

In terms of limitations, the sample was predominantly female and represented the general population of working individuals from just one country, thus limiting the generalizability of the results to other populations. The symptoms of work addiction were measured with single items, which may influence the estimates of network parameters. Finally, the data were cross-sectional, thus causal inference is limited.

4.2. Conclusion, implications, and future studies directions

This study showed that burnout and engagement components were closely associated and more with each other than work addiction which supports the notion that engagement and burnout represent polar opposites of the same construct. It also strongly corroborates the assumption that work addiction is a separate phenomenon, related to both of them *via* specific pathways. The symptoms of work addiction were connected with other phenomena through four direct relationships: (1) mood modification—absorption, (2) mood modification—stress, (3) withdrawal—absorption, and (4) problems—exhaustion. Based on these, feasible mechanisms leading from work engagement to burnout through work addiction can be suggested. These focus on the absorption component and mood modification related to efforts focused on alleviating chronic stress and negative emotional states. In turn, problems arising from work addiction may lead to exhaustion. The current network analysis study provided data on feasible mechanisms leading from engagement to burnout through work addiction. These should be investigated in detail in subsequent studies, which may lead to proper prevention programs and therapeutic interventions.

Three potential interventions, which can benefit both individuals at risk of developing work addiction and individuals already addicted to work, can be proposed based on the results of this study. First, it is worth informing and instructing the individuals that it is healthier for them to alleviate the experienced stress through active problem-solving, support from friends and family, and/or mindfulness practice rather than excessive work (the relationship between perceived stress and mood modification). Second, it is crucial to teach the individuals the difference between positive absorption into work, which increases their focus and productivity during a few hours (such as flow; Schaufeli et al., 2002), and negative absorption into work, which results in negligence

of other areas of life, interpersonal relationships, and other needs in the span of several days, weeks, or months (the relationships between absorption and mood modification and withdrawal). Third, it is important to educate the individuals that they can perform on a certain level only for a specific number of hours during each day and that working extra hours for longer periods leads to work-related problems, job burnout, and eventually reduced job performance (the relationship between exhaustion and problems).

Future studies should focus on further investigation of networks, including work addiction symptoms and dimensions of other work-related phenomena. The possible extensions of our work include: (1) the estimation of networks with additional work-related phenomena (e.g., work-life conflict), (2) the estimation of the network with the same phenomena measured with different instruments, or (3) the estimation of moderated network models including various work-related phenomena as moderators (Haslbeck et al., 2021). Moreover, intensive longitudinal methods might allow the investigation of direct causal relationships between work addiction symptoms and dimensions of other work-related phenomena. Last but not least, replications of this study are also highly warranted.

Data availability statement

The original contributions presented in this study are included in the article/**Supplementary material**, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by the Norwegian Data Protection Official for Research and the Research Ethics Committee at the Institute of Psychology of the University of Gdańsk in Poland. The patients/participants provided their written informed consent to participate in this study.

Author contributions

PB assisted with obtaining funding, literature search, study design and concept, statistical analyses, data interpretation, generation of the initial draft of the manuscript, manuscript preparation and editing, final editing, and approval of the manuscript. PA assisted with the literature search, study design and concept, data collection, data interpretation, manuscript preparation and editing, final editing, and approval of the manuscript. RK assisted with the study design and concept, manuscript preparation and editing, final editing, and approval of the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2023.1130069/full#supplementary-material

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5.5 Załącznik E - ARTYKUŁ 4

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ORIGINAL ARTICLE

Similarities and Differences Between Study Addiction and Study Engagement and Work Addiction and Work Engagement: A Network Analysis

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Abstract

This study aimed to investigate the relationships between symptoms of study addiction and their relationships with dimensions of study engagement. We used two samples in which study addiction was measured with the Bergen Study Addiction Scale and study engagement was measured with the Utrecht Work Engagement Scale for Students. The samples comprised Norwegian ($n = 1107$) and Polish ($n = 776$) students. The networks featured three clusters of nodes (two clusters of the study addiction symptoms and one cluster of the study engagement dimensions). Study addiction clusters were connected with study engagement cluster through positive edges between absorption and study addiction symptoms, negative edges which vigor shared with conflict and problems, and negative edge between dedication and mood modification. Among the symptoms of study addiction, problems, conflict, and withdrawal were the most central and salience, tolerance, and mood modification were the least central. Moreover, conflict was the most predictable and relapse was the least predictable symptom of study addiction. The results from the present study are similar to those of previous studies on work addiction and support the notion that study addiction may be a precursor to work addiction. Although based on cross-sectional data, the nuanced differences between work addiction and study addiction networks are discussed as they lay a foundation for further investigation of the potential differences in transition mechanisms from healthy engagement to compulsive behavior.

Keywords Network analysis · Study addiction · Study engagement · Workaholism · Work addiction · Work engagement

School and academic pressures have been growing the last decades (Cosma et al., 2022; Klinger et al., 2015). Such pressure is associated with declines in well-being among adolescents and young adults (De Looze et al., 2020; Pascoe et al., 2020) as well as widespread phenomena such as educational burnout (Kaggwa et al., 2021; Walburg, 2014). Increasing demands on students may push them into complete focus on studying to the exclusion of other developmental challenges relevant to their age group, particularly the development of close and mature social relationships, friendships, emotional self-regulation, and healthy self-image, in addition to individual passions and spare time

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activities (Atroszko & Atroszko, 2020a). "Study addiction" (Atroszko, 2013), "compulsive study behavior" (Woropay-Hordziejewicz et al., 2022), and "studyholism" (Loscalzo & Giannini, 2018a) are terms used to describe the phenomenon of problematic overstudying. Since student learning and associated coursework can be considered work (Griffiths et al., 2018), problematic overstudying has been conceptualized as an early form of work addiction (Atroszko, 2015, 2022a, 2022b). Study and work addiction share the following: (i) phenomenological manifestation (appetitive effects, distinctive craving, loss of control, and withdrawal symptoms; cf., Sussman, 2012), (ii) characteristic risk factors (e.g., perfectionism and family dynamics), (iii) specific comorbidities (e.g., eating disorders; Woropay-Hordziejewicz et al., 2022), (iv) distinctive consequences (e.g., health problems due to stress associated with extended mental work), and temporal stability (Atroszko et al., 2016a; for a detailed comparison see Atroszko, 2022a). Work addiction is associated with previous study addiction in longitudinal studies (Atroszko et al., 2016b).

The aim of this study was to investigate whether the structure of symptoms of study addiction is analogous to the structure of symptoms of work addiction. Furthermore, the goal was to inquire whether study engagement components are associated with study addiction similarly to relationships between work engagement and work addiction components. If data substantiated this, it would lend support to the hypothesis that study addiction represents an early form of work addiction, and that the two constructs share a similar mechanism of transition from healthy engagement to compulsive behavior.

Some researchers theorize that problematic overstudying might be a reflection of obsessive-compulsive disorder (Loscalzo & Giannini, 2018a). However, several factors are inconsistent with this hypothesis: (i) study addiction lacks characteristics typical for obsessive-compulsive disorders and behaviors (Atroszko, 2019), (ii) study addiction refers to planned behavior involving higher-order cognitive processes and attempts to achieve some appetitive effect and satiation through engagement in it (cf. Sussman, 2012; Sussman & Sussman, 2011), and (iii) study addiction manifests with typical addiction symptoms of craving, loss of control, withdrawal, tolerance, and obsession (Atroszko, 2022b). Moreover, (iv) about one-third of students manifesting all study addiction symptoms have low and very low levels of obsessive-compulsive personality disorder (OCPD) symptomatology (Atroszko et al., 2023b). Perfectionism associated with OCPD may still be a strong risk factor in many cases, analogously to work addiction (Atroszko et al., 2020); however, all these premises suggest that problematic overstudying can be viewed as an addictive disorder/problem and measured as such.

Previous studies show that study addiction is associated with a wide range of disadvantageous phenomena, including lower general health, lower quality of life, poor sleep, loneliness, less perceived support from friends, high perceived stress and exam stress, high cardiovascular reactivity to stress in situations of academic evaluation, high competitiveness component of Type A Personality which is associated with cardiovascular risk, neuroticism, psychasthenia, narcissism, pessimism, and worse academic performance (Atroszko, 2015; Atroszko et al., 2019; for an overview, see Atroszko, 2022a, 2022b). Study addiction is associated with other psychopathologies, including depression and anxiety, social anxiety, and eating disorders (Atroszko, 2015; Lawendowski et al., 2020; Woropay-Hordziejewicz et al., 2022), as well as other addictive behaviors related to food intake, social networking sites usage, shopping, gaming, and pornography (Atroszko et al., 2021; Charzyńska et al., 2021).

More nuanced analyses show that study addiction is associated with maladaptive perseverance (Czerwiński et al., 2023). Similarly, social anxiety is associated with impaired academic performance but only among those who have high study addiction (Lawendowski et al., 2020). These findings lend support to the notion that study addiction is clearly a

negative and counterproductive phenomenon. Moreover, they support the model of study addiction as a result of ineffective stress-coping strategy (Atroszko, 2015) in which increased effort and perseverance among those who struggle with other problems in life (such as social anxiety) gradually turns into compulsion and leads to narrowing down of life interests and sources of pleasure. The increasing priority given to study behavior to the extent that it takes precedence over other life interests and daily activities is a core symptom of addiction (c.f., World Health Organization, 2019).

The current study will provide data on the structure of symptoms of study addiction and components of learning engagement, elucidating potential mechanisms of transition from healthy passion towards learning to compulsive behavior. While it is based on cross-sectional data, it will still allow for narrowing down and testing hypotheses concerning these mechanisms, which can be subsequently investigated with longitudinal designs.

Study addiction shows a similar prevalence to work addiction (Andersen et al., 2023). It seems to be among the most prevalent addictive behaviors and has higher prevalences when compared to gaming, shopping, food, pornography, and social networking sites addiction in the same sample of students and using a similar methodology for prevalence estimation (Atroszko et al., 2021; see Moskalewicz et al., 2019). The available estimates of study addiction suggest prevalences ranging from about 6 to 17% depending on country and sample type (Atroszko et al., 2019 for an overview, see Atroszko, 2022a). However, more recent analyses suggest that these rates may reflect overestimations because of the imperfect cut-off applied (Atroszko et al., 2023a; Bereznowski & Konarski, 2020). Studies with improved cut-off methodology conducted on nationally representative samples are necessary to evaluate the scale of this problem worldwide.

The Bergen Study Addiction Scale (BStAS; Atroszko et al., 2015) has proved to be a valid and reliable measure that assesses seven components of study addiction (i.e., salience, tolerance, mood modification, relapse, withdrawal, conflict, and problems; see Griffiths, 2005). It is based on the Bergen Work Addiction Scale (BWAS; Andreassen et al., 2012) which reflects the same components of addiction. It has been used among undergraduate and high school students worldwide, including in Poland, Norway, Turkey, Germany, Italy, Portugal, the USA, and India (Atroszko et al., 2015; Atroszko, Buźniak, et al., 2023a; Bisht & Godiyal, 2016; Charzyńska et al., 2021; Czerwiński et al., 2023; Godzwon et al., 2022; Kircaburun et al., 2021; Kozak et al., 2020; Lawendowski et al., 2020; Loscalzo & Giannini, 2018b; Schaefer & Strob, 2023; Wróbel, 2020).

BStAS scores correlate positively with learning engagement (Atroszko, 2015; Atroszko et al., 2015; Czerwiński et al., 2023; Lawendowski et al., 2020; Wróbel, 2020) and its components, especially with absorption (Atroszko & Atroszko, 2019). High time and effort involvement characteristic of both phenomena, to a large degree, account for these associations. Nonetheless, studies show that learning engagement is positively related to well-being and academic/school performance, whereas study addiction is linked to deteriorated psychosocial functioning (Atroszko, 2022b). Moreover, the absorption component of engagement may be a doorway to addiction because it phenomenologically is very similar to the experience of the "high" obtained with drugs. When students are absorbed in studying, they feel elated, and while fully focused, they forget about everything else and may have difficulties detaching from studying. Among individuals at risk, this gratifying experience may lead to the development of compulsive behavior because they may use this "high" produced by studying to escape from difficult emotions, stress, and other life problems (Jouhki & Oksanen, 2022). This mechanism is supported in network analysis studies of the structure of work addiction symptoms, work engagement components, stress, and burnout (Bereznowski et al., 2023a).

Previous studies in Norway and Poland used a network analytic approach to investigate the structure of components of work addiction measured with the BWAS. They showed two clusters of symptoms. Cluster 1 included tolerance, relapse, conflict, and problems, and Cluster 2 included salience, mood modification, and withdrawal (Bereznowski et al., 2022). Relapse had the highest network centrality. It was operationalized as the extent to which others told an individual to cut down on work without listening to them. It could represent its essential role as a diagnostic criterion. Work addiction is likely best identified when people close to those addicted recognize and communicate their overinvolvement in work.

On the other hand, mood modification had the lowest network centrality and predictability (Bereznowski et al., 2022), which likely represents its nature as a bridge linking healthy engagement with addiction (Bereznowski, Atroszko, & Konarski, 2023a). Conflict had the highest predictability in the networks, showing that other symptoms of addiction may affect it to the most significant degree. This finding is congruent with the notion that work addiction fuels work/life conflict (Clark et al., 2016), leading to a host of negative consequences for the addicted individuals and people around them (Atroszko & Atroszko, 2020b), including colleagues at work, subordinates, recipients of work, and in family, particularly children, and friends (Atroszko, 2022a)

Network analyses have been conducted to investigate associations of work addiction symptoms with work engagement dimensions of absorption, dedication, and vigor (Bereznowski, Atroszko, & Konarski, 2023a; Bereznowski, Bereznowska, et al., 2023b). The results suggest that the absorption dimension of work engagement and the mood modification component of work addiction could constitute a bridge between healthy engagement and addiction to work. Mood modification and absorption had the highest centrality in the networks based only on edges with other phenomena. Vigor was negatively related to mood modification, conflict, and problems showing that this dimension of engagement is clearly positive and opposite to central addiction symptoms. Dedication was positively related to tolerance and negatively linked to mood modification, suggesting that it is associated with a tendency to do more work but not regulated by a typical addictive mechanism of emotional escapism but rather by positive feelings of being devoted to work.

Based on the assumption that study addiction is an early form of work addiction and that mechanisms of transition between healthy engagement and addiction are analogous in the domains of studying and working, it can be expected that structures of networks of study addiction and study engagement will correspond to previously reported results found in research on work engagement and addiction networks (Bereznowski et al., 2022; Bereznowski, Bereznowska, et al., 2023b). Most importantly, the structures will reflect the hypothetical transition process from engagement to addiction via absorption and mood modification components (see Fig. 1). Against this backdrop, we conducted a network analysis study investigating the relationship between study addiction and work addiction symptoms in two samples of students. The following hypotheses were posited:

Hypotheses

Hypothesis 1: The study addiction networks will have a topology similar to the work addiction networks, which will be observable by the following:

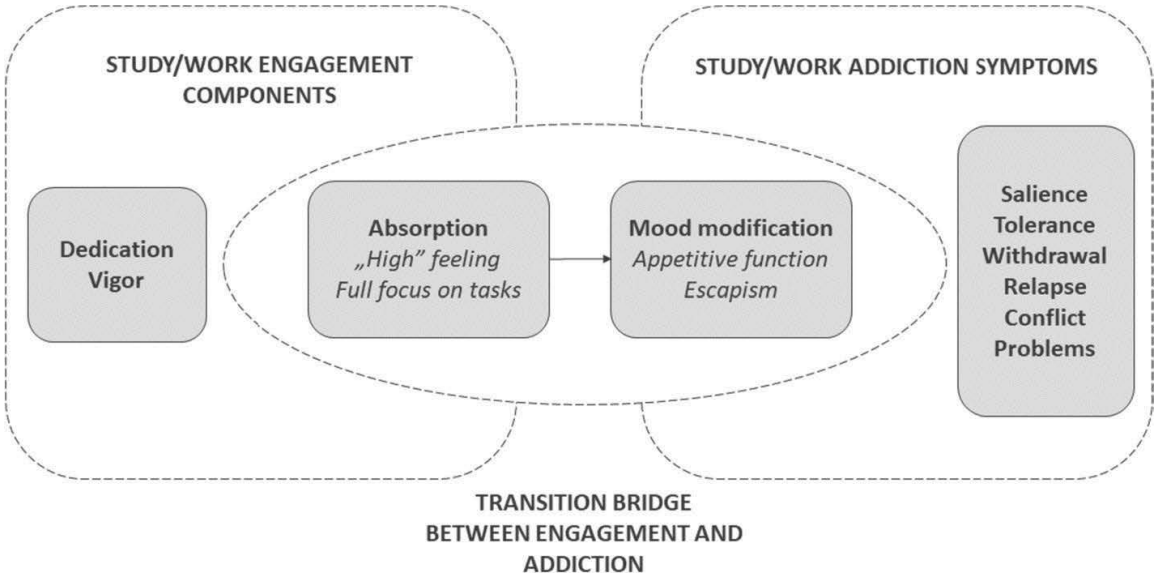

Fig. 1 The visual representation of the hypothetical transition process from engagement to addiction via the absorption component of engagement and mood modification symptom of addiction

- H1A: The study addiction networks will include two clusters of symptoms (cluster 1: tolerance, relapse, conflict, and problems; cluster 2: salience, mood modification, and withdrawal).
- H1B: Relapse will have the highest centrality and mood modification will have the lowest centrality in the study addiction networks.
- H1C: Conflict will have the highest predictability and mood modification will have the lowest predictability in the study addiction networks.

Hypothesis 2: The study addiction and study engagement network will have topologies similar to the work addiction and work engagement network, which will be observable by the following:

- H2A: The study addiction and study engagement networks will include three clusters of nodes (two clusters of study addiction symptoms (see H1A) and one cluster of study engagement dimensions).
- H2B: Absorption will be positively related to all symptoms of study addiction.
- H2C: Vigor will be negatively related to mood modification, conflict, and problems.
- H2D: Dedication will be positively related to tolerance and negatively related to mood modification.
- H2E: Mood modification and absorption will have the highest centrality (based only on edges with other phenomena) in the study addiction and study engagement networks.

Method

Study Design

Data collection was based on convenience sampling and took place from September to December 2014 in Norway (Sample 1) and from October 2014 to January 2015 in Poland (Sample 2). The two samples were recruited as part of longitudinal study on study

addiction (Atroszko et al., 2016a). The participants completed online surveys. They were invited to take part in the survey either via university e-mailing system or via an announcement on a university website. Participation was anonymous but each participant was eligible to participate in a gift cards raffle. There were 60 gift cards (500 NOK) for participants from Norway and 100 gift cards (50 PLN) for participants from Poland.

Ethics

The study was reviewed and approved by both the Norwegian Data Protection Official for Research and the Research Ethics Committee at the Psychology Department of the University of Gdańsk in Poland. Neither of these committees regarded attaining written informed consent as necessary as voluntary completion of the survey was regarded as providing consent.

Participants

The samples included responses from 1107 studying Norwegians and 776 studying Poles. In Norway, 806 women and 301 men participated, and their mean age was 24.49 years ($SD = 4.37$). In Poland, 640 women and 136 men took part, with a mean age of 22.01 years ($SD = 1.71$). Detailed demographic and study-related information about participants are presented in Table 1.

Measures

Participants were asked about basic demographic information (sex, age, and marital status) and basic study-related information (mode of study (full time vs. part time) and number of hours devoted to studying weekly).

Table 1 Demographic and study-related characteristics of the samples

	Norway	Poland
N	1107	776
Sex		
Women	806 (72.8%)	640 (82.5%)
Men	301 (27.2%)	136 (17.5%)
Age (*M* (*SD*))	24.49 (4.37)	22.01 (1.71)
Marital status		
In a relationship	637 (57.5%)	385 (49.6%)
Not in a relationship	470 (42.5%)	391 (50.4%)
Mode of study		
Full time	1064 (96.1%)	715 (92.1%)
Part time	47 (4.2%)	83 (10.7%)
Number of hours devoted to studying weekly (*M* (*SD*))	34.22 (13.20)	37.10 (18.93)

Study Addiction

The Bergen Study Addiction Scale (BStAS; Atroszko et al., 2015) is a modified version of the Bergen Work Addiction Scale (BWAS; Andreassen et al., 2012) in which "work," "working," and "worked" are replaced with "study," "studying," and "studied" (e.g., "How often during the last year have you thought of how you could free up more time to study?"). This measure consists of seven items, one for each symptom of addiction (Griffiths, 2005). The respondents evaluated the frequency of each symptom over the past twelve months. Responses are provided on a 5-point Likert scale ranging from 1 (*never*) to 5 (*always*). The measure does not have a skip structure and the responses were not preprocessed in any way. The Norwegian and Polish versions showed good content, convergent, criterion, and factor validity in previous studies (Atroszko, 2015; Atroszko et al., 2015, 2016a, 2016b). In this study, the Cronbach's alpha reliability coefficient were .81 in the Norwegian sample and .82 in the Polish sample, respectively.

Study Engagement

The Utrecht Work Engagement Scale for Students (UWES9-S; Schaufeli & Bakker, 2004) is a modified version of the Utrecht Work Engagement Scale (UWES9; Schaufeli et al., 2006). The items are rephrased in order to fit the studying context (e.g., "At my work, I feel bursting with energy" was rephrased to "When I'm doing my work as a student, I feel bursting with energy"). The UWES9-S consists of nine items, three for each dimension of study engagement: vigor, dedication, and absorption. The respondents evaluate the frequency of each statement in general (without a specified time frame). Responses are provided on a 7-point Likert scale ranging from 1 (*never*) to 7 (*everyday*). The measure does not have a skip structure. Responses were preprocessed by summing the scores of items representing each dimension (i.e., the items of UWES9-S were responsible for three nodes in the networks (vigor, dedication, and absorption)). The Norwegian and Polish versions of the UWES9 showed good content, convergent, criterion, and factor validity in previous studies (Nerstad et al., 2010; Pollak et al., 2017). In the present study, the Cronbach's alpha reliability coefficient were 0.88 for vigor, 0.89 for dedication, and 0.87 for absorption in the Norwegian sample and 0.79 for vigor, 0.85 for dedication, and 0.76 for absorption in the Polish sample, respectively.

Statistical Analyses

We estimated two pairs of networks (i.e., four networks). In each of the pairs one of the samples were Norwegian and one Polish. In the first pair, we estimated the networks including study addiction symptoms only, and in the second pair, we estimated the networks including study addiction symptoms and study engagement dimensions. The analyses were performed in R version 4.2.2 (R Core Team, 2022), and the network's visualizations were created with the qgraph 1.9.3 package (Epskamp et al., 2012). To report the results, we followed the guidelines set by Burger et al. (2022). The analytical code is available at https://osf.io/f5vsq/?view_only=ab6f0e77ce054c759fca0506a2ffe5bf.

Network Estimation

Each pair of networks was estimated jointly using fused graphic lasso (FGL) method and the EstimateGroupNetwork 0.3.1 package, which is the recommended method for joint network estimation (Costantini & Epskamp, 2017). The optimal values of the tuning parameters were selected via k-fold cross-validation with seed set to 1. Layouts for visualizations were based on the layouts calculated for networks of work addiction and work engagement in previous studies (Bereznowski et al., 2022; Bereznowski, Bereznowska, et al., 2023b). The clusters of nodes were identified with a spin-glass algorithm implemented in the igraph 1.4.1 package (Csardi & Nepusz, 2006). This exploratory algorithm was designed to detect the optimal number of clusters in the network (we did not change the default values of the parameters, which allow detection of up to 25 clusters).

Network Stability

The stability of the networks was evaluated with the bootnet 1.5 package (Epskamp et al., 2018), and its implementation of nonparametric bootstrapping and case bootstrapping was based on 1000 bootstrap samples. The stability of each network was measured with the correlation stability coefficient, which represents "the maximum proportion of cases that can be dropped, such that with 95% probability the correlation between original centrality indices and centrality of networks based on subsets is 0.7 or higher" (Epskamp et al., 2018, p. 200). The stability of the network is regarded as acceptable when the correlation stability coefficient exceeds 0.25 and as good when it exceeds 0.50 (Epskamp et al., 2018).

Network Inference

For all networks, we calculated the standard version of the node strength which is equal to the sum of absolute values of all edges connecting a given node with other nodes in the network. Additionally, for study addiction and study engagement networks, we calculated a modified version of the node strength which allows to better capture which nodes are responsible for bridges between different phenomena. The modified version of the node strength is equal to "the sum of absolute values of all edges of a given node to all other nodes which represent different psychological phenomenon" (Bereznowski, Bereznowska, et al., 2023b, p. 11; e.g., for vigor, edges between vigor and study addiction symptoms). In order to compare the pairs of networks with respect to both standard and modified version of the node strength, we calculated Spearman correlation coefficients.

For all networks, we estimated the predictability of nodes using the mgm 1.2–13 package (Haslbeck, 2019). For ordinal data (symptoms of study addiction), node predictability indicates how much a node "can be predicted by all other nodes in the network, beyond what is trivially predicted by the marginal distribution" (Haslbeck & Waldorp, 2018, p. 856). For continuous data (dimensions of study engagement), node predictability indicates the proportion of variance explained by all other nodes in the network.

Network Comparison

We used NetworkComparisonTest 2.2.1 package (van Borkulo et al., 2017) with a seed set to 1 to compare pairs of networks. We started with the omnibus test, which determines whether there are any differences between networks in terms of edge weights. When the

omnibus test was significant, we performed the post hoc test (with Holm-Bonferroni correction) to identify which specific edges were different. Finally, we compared the pairs of networks with respect to global strength (the sum of all absolute edge weights in the network).

Results

Descriptive Statistics

Skewnesses, kurtoses, means, and standard deviations of the seven symptoms of study addiction and the three dimensions of study engagement are presented in Table 2. The skewnesses and kurtoses indicated that the study variables' distributions deviated from the normal distribution. However, since a recent simulation study showed that transformation of skewed ordinal data has negligible effects on the performance of network estimators (Isvoranu & Epskamp, 2023), we decided not to apply any transformation. By this approach we enable our results to be directly comparable with the work addiction and work engagement studies in which the raw data were analyzed (Bereznowski et al., 2022; Bereznowski, Bereznowska, et al., 2023b).

Network Analysis

Study Addiction Networks

The two addiction networks were accurately estimated. Their correlation stability coefficients were 0.75 for Norway and 0.59 for Poland, both indicating good stability. The networks are visualized in Fig. 2. The network density equaled 0.90 (19/21 edges) in Norway and 0.86 (18/21 edges) in Poland. In both cases, the mean absolute edge weight equaled 0.11. The spin-glass algorithm identified two identical clusters in both networks. The first cluster included salience (1), mood modification (3), and withdrawal (5), and the second

Table 2 Means, standard deviations, skewness, and kurtosis of the seven symptoms of study addiction and the three dimensions of study engagement

No.	Node	Skewness (kurtosis)		*M* (*SD*)	
		Norway	Poland	Norway	Poland
1	Salience	− 0.37 (2.73)	− 0.30 (2.56)	3.09 (0.97)	3.07 (0.98)
2	Tolerance	0.41 (2.68)	0.07 (2.26)	2.36 (0.93)	2.79 (1.00)
3	Mood modification	0.88 (2.74)	0.73 (2.50)	1.89 (1.03)	2.06 (1.08)
4	Relapse	1.29 (4.01)	1.20 (3.49)	1.72 (0.96)	1.76 (1.03)
5	Withdrawal	− 0.06 (2.32)	0.28 (2.32)	2.82 (1.10)	2.58 (1.15)
6	Conflict	− 0.05 (2.17)	− 0.02 (2.06)	2.89 (1.10)	2.79 (1.17)
7	Problems	0.87 (3.04)	0.87 (2.74)	1.98 (1.03)	1.92 (1.05)
8	Vigor	− 0.03 (2.25)	0.23 (2.40)	14.27 (4.24)	12.59 (3.95)
9	Dedication	− 0.53 (2.64)	− 0.22 (2.10)	17.93 (4.18)	16.40 (4.69)
10	Absorption	− 0.06 (2.20)	0.06 (2.17)	14.94 (4.41)	13.75 (4.29)

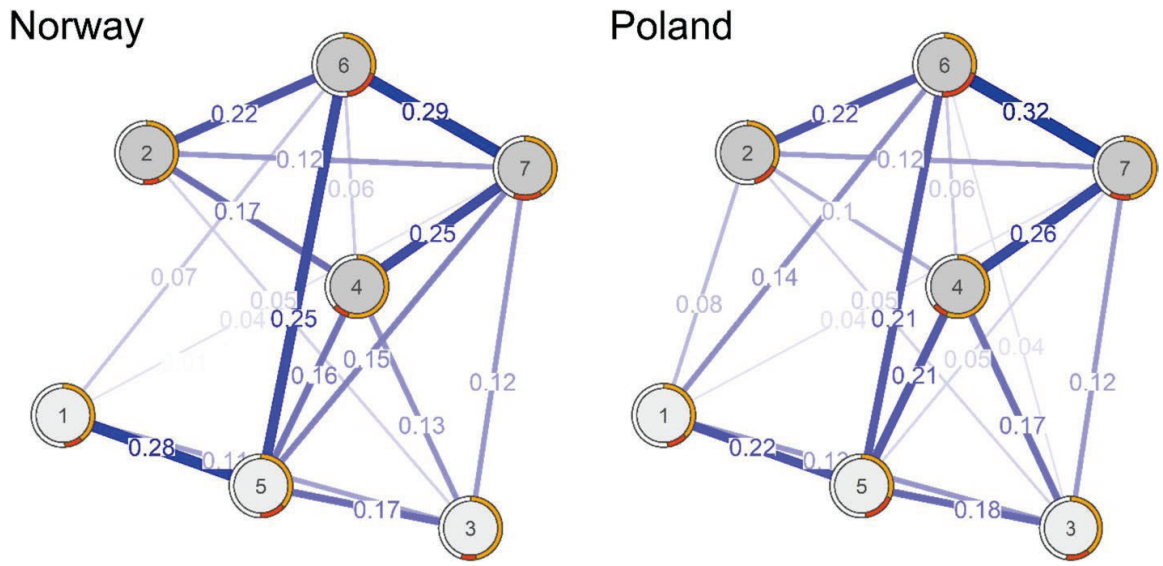

Fig. 2 The regularized partial correlation networks of study addiction. The less (more) pathological symptoms of study addiction are represented by lighter (darker) gray nodes. Blue (red) lines represent positive (negative) edges. The strength of a relationship is represented by line thickness and darkness. The orange area in the ring around a node represents predictability based on a node's marginal distribution. The red area represents predictability based on the variance of a symptom explained by its neighbors. 1 = salience; 2 = tolerance; 3 = mood modification; 4 = relapse; 5 = withdrawal; 6 = conflict; 7 = problems

cluster included tolerance (2), relapse (4), conflict (6), and problems (7). These two clusters are identical to the clusters observed for work addiction (Bereznowski et al., 2022).

In both networks, salience (1), tolerance (2), and mood modification (3) were among the least central symptoms, and withdrawal (5), conflict (6), and problems (7) were among the most central symptoms (standard version of the node strength; see Fig. 3). However, there were small variations between samples with respect to the exact order of point estimates of centrality for these symptoms. Spearman correlation coefficient of the standard version of the node strength equaled 0.82.

The average predictability equaled 19.3% in Norway and 21.6% in Poland (41.9% and 39.1%, respectively, when including marginal distributions). The most predictable symptom in Norway and Poland was conflict (6) with predictability equal to 18.2% and 21.7%, respectively. The least predictable symptom was mood modification (3) in Norway (7.8%) and relapse (4) in Poland (7.9%, while predictability of mood modification equaled 12.8%).

The omnibus test was statistically significant, $p = 0.022$. Five out of 21 edges (23.8%) differed significantly: salience (1)—tolerance (2), tolerance (2)—relapse (4), salience (1)—withdrawal (5), salience (1)—conflict (6), and withdrawal (5)—problems (7). The networks did not differ with respect to global strength, $p = 0.314$.

Study Addiction and Study Engagement Networks

The two addiction and engagement networks were accurately estimated. Their correlation stability coefficients were 0.67 for Norway, and 0.75 for Poland, both indicating good stability. The networks are visualized in Fig. 4. The network density equaled 0.47 (21/45 edges) in Norway and 0.56 (25/45 edges) in Poland. In both cases, the mean absolute edge weight equaled 0.10. The spin-glass algorithm identified two identical clusters in both networks. First cluster included the study addiction symptoms, and the second cluster included the study engagement dimensions.

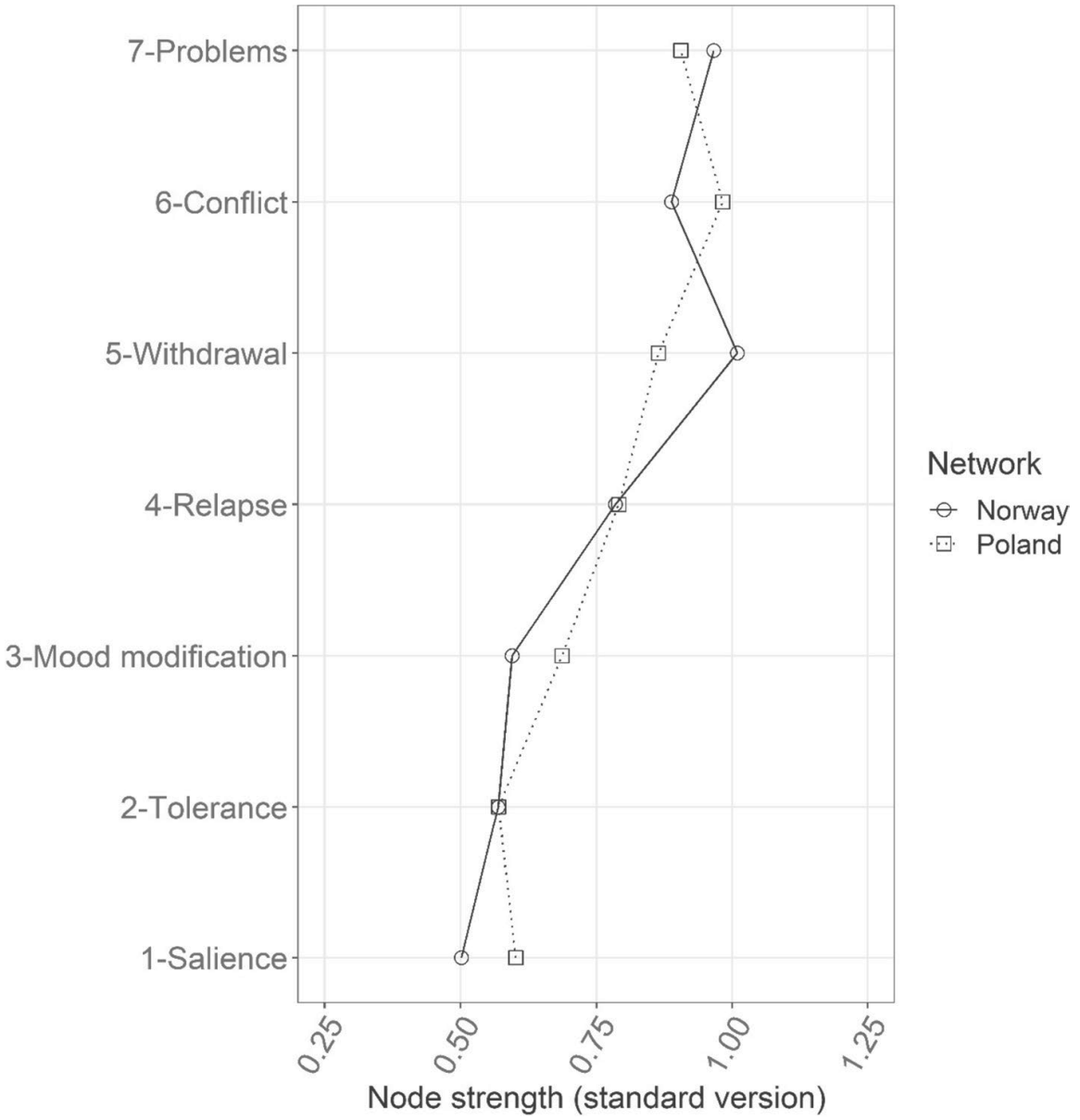

Fig. 3 The unstandardized values of the standard version of the node strength in the study addiction networks

In both networks salience (1) was the least central symptom of work addiction, whereas problems (7) was the most central symptom of work addiction, dedication (D) was the least central dimension of study engagement, whereas absorption (A) was the most central dimension (see Fig. 5A for standard version of the node strength and Fig. 5B for the modified version of the node strength). Spearman correlation coefficient equaled 0.95 for the standard version of the node strength and 0.94 for the modified version of the node strength.

The average predictability equaled 33.4% in Norway and 33.2% in Poland (57.0% and 54.7%, respectively, when including marginal distributions for symptoms). The most predictable symptom in Norway and Poland was conflict (6) with predictability equal to 20.7% and 23.0%, respectively. The least predictable symptom in Norway and Poland was relapse with predictability equal to 8.5% and 7.9%, respectively. Mood modification had predictability equal to 8.4% in Norway and 11.5% in Poland. The most predictable dimension in Norway and Poland was absorption (A), 67.0% (Norway) and

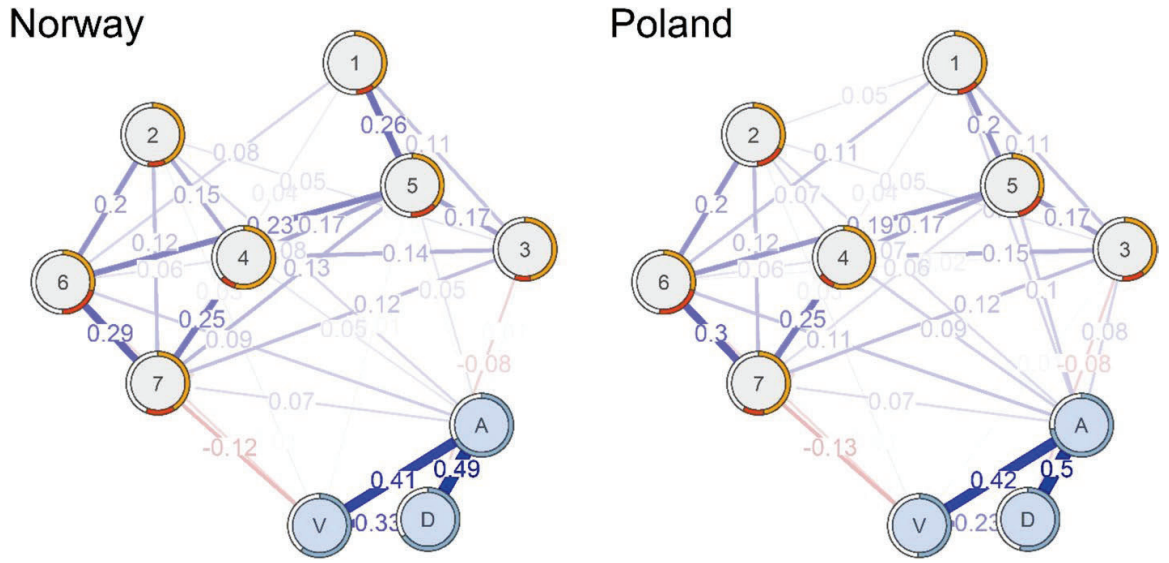

Fig. 4 The regularized partial correlation networks of study addiction and study engagement. The symptoms of study addiction are represented by gray nodes and the dimensions of study engagement are represented by blue nodes. Blue (red) lines represent positive (negative) edges. The strength of a relationship is represented by line thickness and darkness. In the case of symptoms of study addiction, the orange area in the ring around a node represents predictability based on the marginal distribution of a node and the red area represents predictability based on the variance of a symptom explained by its neighbors. In the case of dimensions of study engagement, the blue area in the ring around a node represents a proportion of variance explained (R^2). 1 = salience; 2 = tolerance; 3 = mood modification; 4 = relapse; 5 = withdrawal; 6 = conflict; 7 = problems

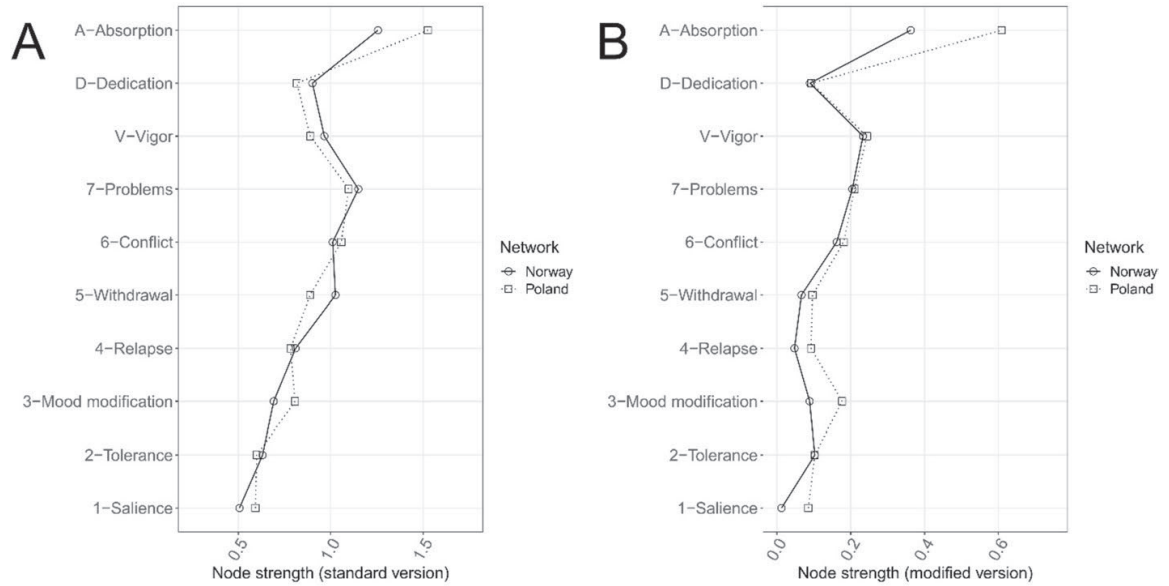

Fig. 5 **A** The unstandardized values of the standard version of the node strength in the study addiction and study engagement networks. **B** The unstandardized values of the modified version of the node strength in the study addiction and study engagement networks

73.1% (Poland), whereas the least predictable dimension was vigor, 60.1% (Norway) and 50.7% (Poland).

The omnibus test was statistically significant, $p < 0.001$. Twelve out of 45 edges (26.7%) differed significantly: salience (1)—tolerance (2), tolerance (2)—relapse (4), salience

(1)—withdrawal (5), withdrawal (5)—conflict (6), and withdrawal (5)—problems (7), conflict (6)—vigor (V), salience (1)—absorption (A), mood modification (3)—absorption (A), relapse (4)—absorption (A), conflict (6)—absorption (A), vigor (V)—absorption (A), and vigor (V)—dedication (D). The networks did not differ with respect to global strength, $p = 0.619$.

Discussion

The present study aimed to investigate the relationships between study addiction symptoms and study engagement components in the two samples with diverse cultural backgrounds. The networks in Poland and Norway were almost identical, with a few minor differences. For example, there was a weak association between salience and tolerance, and mood modification and absorption in Poland, while in Norway, there was none. While this may reflect cultural differences, it has to be emphasized that within the full complex nature of interrelationships between ten nodes and possible 90 edges and the overwhelming similarity of structures, the aforementioned differences are trivial and need further replication. These overall between-country resemblances parallel remarkable similarities found previously in work addiction networks in samples from different countries and of diverse sociodemographic makeup (Bereznowski et al., 2022; Bereznowski, Bereznowska, et al., 2023b).

Similar to the structure of work engagement and work addiction components, we identified three distinct clusters of nodes: one cluster for the dimensions of study engagement and two clusters for study addiction symptoms (H1A and H2A supported). Contrary to the expectations, relapse did not have the highest centrality (H1B not supported), but problems (7), conflict (6), and withdrawal (5) had relatively similar and highest centrality in both samples. These are very interesting results suggesting that compared to working populations, for students, being told by others to cut down on studying without listening to them is not as diagnostically central. It may be that it happens less often than in relation to work because studying is socially highly valued and praised, and spending long hours on it is expected by parents, teachers, and even peers. It is also conceivable that fewer students than workers are in a steady relationship, which, compared to workers would reduce the chances of interpersonal reactions to specific behaviors. In line with this, working too much may more directly conflict with other roles and obligations in life, such as family-related (Atroszko, 2022a; Clark et al., 2016; Robinson, 2014). Therefore, the problem of overworking may be more easily observed and recognized by others than the problem of overstudying. Instead, symptoms associated with negative consequences of study addiction (problems and conflict) and withdrawal had the highest centrality in Poland and Norway. It indicates that these may constitute core diagnostic criteria representing crucial addictive mechanisms and processes.

Mood modification (3), together with salience (1) and tolerance (2), had the lowest centrality in the study addiction networks (H2B partially substantiated). These symptoms may, to a larger degree, represent peripheral processes associated with a higher focus on studying in general, which may, to some extent, be associated with high study engagement or situational factors such as demands from the course, pressures from the environment or socioeconomic pressures (Atroszko, 2013). For a discussion on the differences between study addiction and non-compulsive forms of high study involvement, see Atroszko (2022b). Also, previous work has shown that items representing these symptoms, particularly item

1 (salience) and item 2 (tolerance), are less "diagnostic" in the study and work addiction scales across countries (Atroszko, Buźniak, et al., 2023a; Bereznowski & Konarski, 2020).

Conflict (6) had the highest predictability and mood modification (3) had one of the lowest predictabilities in the four networks (H1C mostly substantiated). The least predictable symptom in three out of the four networks was relapse (4), which was also among the least predictable symptoms of work addiction (Bereznowski et al., 2022). Together these results highlight subtle differences between study addiction and work addiction. These results also indicate that while conflict may arise as a consequence of other study addiction symptoms, the activation of symptoms such as mood modification and relapse is related to factors that are external to the process of addiction. Currently, the only known external factor co-occurring with mood modification is perceived stress, and no external factors co-occurring with relapse are known (Bereznowski, Atroszko, & Konarski, 2023a). Consequently, further work is needed to identify external key factors related to specific symptoms of both study addiction and work addiction.

Interestingly the strength of association between study addiction withdrawal and relapse is more similar to networks found in general populations of working people in Norway and Poland in comparison to those found among younger populations of recent graduates (Bereznowski et al., 2022). This may reflect the progressive nature of addiction and suggest that among undergraduate students, networks resemble more "mature" structures found in relatively older working populations. Hence, study addiction at this stage may result from a longer process that could have started already in high school or earlier (Wróbel, 2020). Future longitudinal studies may shed light on this hypothesis.

The study engagement cluster was connected to the study addiction clusters through the negative edges between vigor (V) and conflict (6) and problems (7) (H2C mostly supported) and positive edges between absorption (A) and all the addiction symptoms in Poland and all but with mood modification in Norway (H2B mostly supported). Unlike networks of work addiction and work engagement, mood modification was only associated positively with absorption (A) in Poland and negatively with dedication (D) in both samples (hypotheses H2D and H2E partially supported). These results indicate that lower energy (vigor) associated with studying co-occurs with internal and external conflicts caused by studying, and associated problems. Also, higher work absorption co-occurs with experiencing all or most addiction symptoms, and higher work dedication co-occurs with a lower tendency to regulate mood with studying. The engagement cluster was more connected to the salience, mood modification, and withdrawal cluster than the other addiction symptoms. This disproportion was similar but less pronounced than in the work addiction and work engagement networks (Bereznowski, Bereznowska, et al., 2023b). This supports the assumption that the first cluster represents less pathological symptoms of work addiction (Bereznowski et al., 2022; see also Charlton & Danforth, 2007).

The notable difference between the current networks and previously identified networks of work addiction and work engagement is the fewer associations between mood modification and engagement components, including the lack of association with absorption (A) in Norway. This may point to some important differences in how mood is regulated by studying compared to how it is modified by work. On the other hand, in both samples, absorption (A) had relatively strongest links to conflict (6). While absorption (A) still seems to be a bridge between engagement and addiction, in the case of studying, the mechanism may involve its more direct association with negative consequences and the less pronounced mediating role of mood regulation. Students engrossed in studying and fully focused on this activity may ignore other spheres of life in a way that leads to harmful outcomes regardless of whether studying relieves them from low mood (or whether they perceive

that it does). It is highly congruent with systematic structural equation modeling studies showing that the tendency to escape from personal problems into studying is not directly associated with neglecting health problems, ignoring social relationships, and depression symptoms, but seems to be mediated by the compulsion component of addiction (Atroszko, 2015, 2022b). These studies also showed that pleasure derived from studying, akin to absorption, had much stronger direct effects on study compulsion than indirect effects via the tendency to escape personal problems by studying.

This mechanism seems to suggest that in relation to study addiction, pleasure and absorption related to studying are stronger risk factors than negative reinforcements in the form of avoiding difficult emotional states, at least at the self-report level. It may be that positive reinforcements and mood regulation related to positive emotions play more important roles than in work addiction, in which escapism motives are either more pronounced or mature adults are more aware of them. It is also likely that these findings are associated with the fact that young adults (and adolescents) have (i) limited insight into their emotion regulation strategies associated with studying, (ii) generally lower insight into their emotional states, and (iii) greater reward-related neural activation (Vijayakumar et al., 2018). All these processes are associated with the maturation of prefrontal regions implicated in cognitive control, emotion regulation, and motivational and affective processing, which are responsible for numerous adverse outcomes during adolescence (e.g., health-risking behaviors, substance abuse, and depression; Vijayakumar et al., 2018). In other words, for some students, studying may be a highly reinforcing activity, and they may not understand and have control in terms of how studying regulates their emotional states. This, however, requires further systematic studies, and the current and novel findings contribute to the foundation for future work in this area.

Practical Implications

Foremostly, the findings provide important knowledge that can guide the prevention of study addiction and likely future work addiction. Passion for learning is a factor that is desirable for the development of young people and should be fostered within educational settings. However, excessive absorption in studying among individuals with risk factors, such as emotional instability, tendency to experience anxiety, high rigid perfectionism, or social anxiety, may lead to compulsive studying and relevant sequelae. The results of the present study draw attention to the need for a more careful evaluation of whether high engrossment in studying among adolescents and young adults reflects a healthy passion for learning or serves other functions that may lead to addictive behavioral patterns.

Moreover, the observed differences between networks of study addiction/engagement and previous networks of work addiction/engagement (Bereznowski, Atroszko, & Konarski, 2023a; Bereznowski, Bereznowska, et al., 2023b), together with findings from research using SEM models (Atroszko, 2015), suggest that young people may have less insight into how studying regulates their mood. Specifically, they may more readily observe how it brings them enjoyment or satisfaction rather than how it may represent an escape from negative emotional states. This is particularly worrisome because it may considerably contribute to a gradual narrowing of interests and sources of pleasure, which is a core symptom of all addictions (World Health Organization, 2019). Especially at the initial stages of the addictive process, vulnerable individuals may choose studying for its positive reinforcement effects while neglecting social relationships, hobbies, and other activities (see Atroszko, 2022b). Perhaps only after facing the harmful severe consequences of their

overstudying (e.g., physical or mental health problems, lost relationships, and loneliness) may some realize that studying have become too central to their life and that they are in a serious predicament with the inability to enjoy anything else.

Based on the current findings, two recommendations seem to be in order. Firstly, screening studies that include the absorption component of engagement may aid early identification of students at risk of study addiction and thus enable supporting them (e.g., guidance/supervision). Secondly, broad psychoeducational programs for the general population of students may emphasize a need for balanced multidimensional development that includes social, emotional, and physical competencies. Also, specific programs within educational settings that focus on developing a wide range of skills, including self-regulatory skills, may reduce not only the risk of study addiction but also other addictive disorders and mental health problems, and is in line with a transdiagnostic approach to prevention (Berking & Lukas, 2015). Especially, it is important to emphasize to young people that overreliance on a single source of pleasure or satisfaction in life may be a pathway to addiction and mental health problems. This may also be one of the focal points in therapy, i.e., working on the problematic beliefs centered around the notion that academic success or work success will automatically translate into lasting happiness and fulfilment.

Strengths and Limitations

The present study included two large samples from different countries of considerably different socioeconomic backgrounds. Study addiction and study engagement were measured with the same instrument (i.e., the BStAS and the UWES-S) in each sample, and the instruments were entirely analogous to measures of work addiction (BWAS) and work engagement (UWES) used in previous studies allowing for direct comparisons between study and work addiction/engagement networks. The dimensions of study engagement were measured with three items each, which should reduce bias related to the unreliability of single-item indicators. The estimated networks included the external field of study addiction symptoms (the external field includes conditions other than addiction symptoms; in this case, the components of study engagement; Borsboom, 2017). It addresses the problem of rare investigation of external fields of mental disorders in psychological networks (Fried, 2020). Consequently, the present study contributes to the literature on compulsive overstudying and behavioral addictions and, at the same time, enriches the still scant literature on the replicability of psychological networks (Borsboom et al., 2017; Forbes et al., 2017a, b) as well as the literature on the external fields of mental disorders.

In terms of limitations, the samples were predominantly female, non-representative, and only from two countries restricting the generalizability of the results to clinical populations and populations from other countries and cultures. The data were cross-sectional, which puts limitations on causal inferences. The different study addiction symptoms were measured with single items, which may bias estimates of network parameters. The analyses did not include other mental disorders and psychological constructs (e.g., educational stress and burnout). This may influence the direct relationships between study addiction symptoms and study engagement components.

Conclusions and Future Study Directions

The present study showed that the structure of networks of study addiction and study engagement are largely analogous to the previously identified structures of networks of work addiction

and work engagement. It supports the notion that study addiction comprises an early form of work addiction. Absorption (part of engagement) showed multiple direct relationships with study addiction symptoms, and mood modification showed few direct relationships with study engagement dimensions. However, some important and interesting differences observed may lay a foundation for further investigation of the potential differences in transitional mechanisms (while taking into account that the current study is cross-sectional) from healthy engagement to compulsive behavior. First, mood modification showed fewer connections with engagement components, suggesting that, in the context of previous studies, positive reinforcements (rather than negative) and/or low insight into emotional self-regulation associated with developmental age (maturation of prefrontal cortex) play a more pronounced role in study addiction than in work addiction. Second, the lower centrality of relapse measured as the extent to which others told an individual to cut down on studying without listening to them suggests that there might be less recognition of the problem of overstudying by people close to them (parents, siblings, teachers, and friends) compared to overworking which more directly conflicts with other roles, such as family-related. Third, symptoms associated with negative consequences of study addiction (problems and conflict) and withdrawal may constitute core diagnostic criteria representing crucial addictive mechanisms and processes. Fourth, among undergraduate students, the strength of association between withdrawal and relapse resembles more "mature" structures found in networks of relatively older working populations. Hence, study addiction at this stage may result from a longer process that could have started already in high school or earlier.

All these findings are novel and open the door to further systematic investigations. Moreover, future studies should investigate networks including additional variables in the external field of study addiction symptoms such as educational burnout, educational stress, perfectionism, and other potential comorbid psychopathologies. Cross-validation of the investigated networks with different item wordings is necessary in order to increase the generalizability of the results and document the validity of networks. Also, studies in clinical samples as well as exploring sex differences in networks are highly warranted. These should include longitudinal designs to investigate whether cross-sectional data is a good representation of a dynamic process of addiction within individuals and to examine the direction of the relationships between engagement and addiction components using structural equation modeling frameworks.

Code Availability The analytic code for all analyses performed in this study is available at https://osf.io/f5vsq/?view_only=ab6f0e77ce054c759fca0506a2ffe5bf.

Author Contribution PB assisted with obtaining funding, literature search, study design and concept, statistical analyses, data interpretation, generation of the initial draft of the manuscript, and final editing and approval of the manuscript. RK assisted with study design and concept and final editing and approval of the manuscript. SP assisted with data collection and final editing and approval of the manuscript. PAA assisted with literature search, study design and concept, data collection, data interpretation, generation of the initial draft of the manuscript, and final editing and approval of the manuscript.

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Declarations

Ethics Approval and Consent The study was carried out in accordance with the Declaration of Helsinki. All gathered data was anonymous, and participants were informed about all the proper details about the study and their role in it, including that they can withdraw at any point. Attaining formal and written informed consent was not regarded as necessary as voluntary completion of the questionnaires was regarded as providing consent, and no medical information was gathered. The study was approved by the Norwegian Data Protection Official for Research and the Research Ethics Committee at the Institute of Psychology of the University of Gdańsk in Poland.

Conflict of interest The authors declare no competing interests.

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